Report on cross-country comparison on existing innovation and living labs

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D5.1 Report on cross-country comparison on existing innovation and living labs

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Executive Summary

Background
This report is Deliverable 5.1 of the H2020 Co-VAL project "Understanding value co-creation in public services for transforming European public administrations". WP5 investigates the concept and method of innovation and living labs, and how living labs and other participatory and experimental methods are used to enable value co-creation based on co-innovation of public services. Deliverable 5.1 is related to Task 5.1, which is a cross-country comparison of the use of innovation labs in the public sector. This work task should provide a review of the literature on living labs and other experimental and participative methods, making 'living labs' the core concept for the review.

Purpose
The report is based on the following research question: ***How are living labs currently used and conceptualised in scientific research and practice, and how does this influence opportunities and limitations regarding value creation and the role of citizens in co-innovation?*** The purpose of the report is to explore conceptual usage, theories and empirical examples of innovation and living lab activities in public services, herein what the literature says about co-creation and co-innovation of services. It also evaluates the limitations of the literature. An answer to the research question is provided in the concluding section of the report.

Method
The report provides a review of current uses and conceptualisations of living labs. The approach taken is 1) a review of the published scientific literature on living labs and the related experimental and participative methods in public, private and civil sectors; 2) a review of a sample of grey literature and research literature in various languages identified by the research partners in their home country; and 3) an analysis of a selection of living lab initiatives across partner countries.

Overview of findings
The literature speaks of both living labs and innovation labs. For the purpose of this report, we chose to focus on the concept of living labs as it captures co-innovation and co-creation activities across stakeholders and sectors better, while innovation labs tend to have a narrower focus. However, initiatives labelled innovation labs have not been excluded from the review.

The main differences regarding the use and understanding of living labs are mainly related to the research streams and the professions concerned with the approach and less related to specific countries. Thus, the focus of the report shifted from a cross-country comparison of living labs towards a more general literature review – mainly encompassing European literature and living lab initiatives.

The review shows that the living lab phenomenon is a broad phenomenon that can be interpreted in different ways and pull together diverse supporters in different contexts. The literature describes a need for an experimental setting and a safe space for stakeholder involvement and public sector co-creation and innovation, but to what extent actors are willing to or can benefit from this involvement, or what the risks are, is not clear from the literature.

The literature as a whole describes living labs as integrative contexts or spaces for co-creation and innovation. Living labs have at least two main characteristics: they are close-to-reality phenomena (the 'living' part of living labs) while at the same time they are separate from everyday activities (the 'lab' part). As labs, they remove pressures, risks and ethical concerns related to innovation from day-to-day activities in public administration. However, as close-to-reality phenomena, they aim to draw on everyday experiences and actors' interests and perspectives.

The literature review revealed four different tasks that living labs can carry out. These are: exposing and/or appropriating innovation in a user context, co-creating innovation with stakeholders, co-researching innovation with stakeholders, and democratising innovation. Further, the literature speaks of three types of living labs environments: semi-realistic environments, real-life environments, and networks or community environments. A typology is created in section 3.1.3 of the present report based on these dimensions that can be used as a device for positioning the literature and for understanding the different dimensions of living labs and how they can be combined.

The answer given to the research question in the concluding section (cf. Figure 2) is the following: Living labs are currently used and conceptualised as various interactive lab-like spaces and processes of co-innovation. They influence opportunities and limitations regarding value creation and the role of citizens in co-innovation by positioning themselves as possible platforms for integrating methods of innovation, user/stakeholder perspectives and more general values of public services. As such, the literature describes living labs as intermediary practices of innovation and practices of work that bring actors together around an innovation task. At the same time, the literature is concerned with framing the boundaries of living labs to distinguish them from other innovation initiatives, as well as typology work to describe a narrative/history of varied living labs. The literature is also concerned with the legitimacy of living labs in the context of other more mainstream activities in the public sector.

Other main findings from the review are:

- Living labs have emerged in the context of ICT but have spread to other areas of public service, including health services as promising contributions to public value co-creation.
- The literature describes living labs as innovation intermediaries (triple/quadruple helix), as an open innovation methodology and as a contemporary phenomenon.
- Only a few studies apply the term citizens in the definition of a living lab.
- There is little explicit focus on the public sector as more than an actor on the same terms as businesses and civil actors.
- None of the studies are clear in regard to what sort of value is created and for whom.
- No specific definitions of living labs are used consistently in the literature. Living labs appear to have similarities with other experimental innovation frameworks (e.g. participatory design), but the boundaries between them seem to be somewhat blurred and need to be specified.
- The concept of the user as co-creator often seems vague as living labs refer to a great variety of different users in many different contexts. Consequently, current living lab activities involve the design of many specific practices. The people involved are not users but are better conceptualised as practitioners or stakeholders with different interests. Whether their interests are promoted through living labs is unclear.

- Living labs are also described as 'third places' that are not always well-integrated with community developments and practices.
- Finally, there is little emphasis on the evaluation and impact assessment of living lab activities.

Recommendations

The report suggests that there is a need to redefine the understanding of living labs to better reflect how living labs are being put into practice currently. Thus, the report redefines the concept as follows: *Living lab is a conceptualisation of multi-contextual and cross-sectorial experimental user-centric innovation processes with the aim of developing and/or improving welfare products, democratic engagement, services or processes based on the application of co-creation methodologies depicted by transdisciplinarity.*

Finally, for further research, the report suggests seeing living labs against the backdrop of co-production and co-creation initiatives in a wider sense. A typology based on various dimensions of co-production and co-creation is created to provide a framework and sensitising device, which can help guide and position future research and practice. Future research could thus apply a broader view of co-creation processes and evaluate the role, position, and contribution of living labs in these.

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List of Terms and Abbreviations

Abbreviation	Definition
WP	Work Package
ICT	Information and Communication Technology

1 Introduction

This report analyses current uses and conceptualisations of living labs and their experimental and participative methods encompassing public, private and civil sectors, founded on ideals of co-creation and citizen participation. The main method used is a systematic review of published scientific literature on living labs. However, to investigate how scientific research is backed up by practical, context-specific insights and research initiatives, a sample of grey literature and research literature in various languages identified by the research partners in their home country is also reviewed. This literature review is kept separate from the review of the published scientific literature in order to provide insights on what initiatives in policy and research have emerged from national contexts. For the same purpose, a selection of living lab initiatives across partner countries is analysed. Subsequently, the implications of the overall findings are discussed to create a solid foundation for developing empirical studies of living lab activities targeting public services. The review completes Task 1 in work package 5 on living labs in the Co-VAL project.

1.1 Purpose and Scope

The study reports the results of a literature study on living labs and related experimental and participative methods in public, private and civil sectors. The main research question of the study is: '***How are living labs currently used and conceptualised in scientific research and practice, and how does this influence opportunities and limitations regarding value creation and the role of citizens in co-innovation?'***

The aim is to shed light on the citizens' role in co-creation for public value and outline how co-innovation can be understood in a public context. Co-creation and co-innovation are overlapping concepts, which refer to innovation as an interactive process that involves stakeholders such as users in the creation of value. Specifically, in the context of public services, innovation activities are targeted at creating value for citizens and/or society at large. Furthermore, the task contributes to the overall Task 1 in the Co-VAL project to be conducted by WP4, WP5 and WP6: to identify unique characteristics and commonalities across the existing empirical and theoretical literature on value co-creation cases.

1.2 Structure of the Deliverable

The report is structured as follows: firstly, the methods applied will be accounted for, the findings of the different literature reviews are then presented followed by a synthesis in the form of two typologies: one on the identified living lab continuums and one on the methodological approaches of living labs for further research. Finally, the main findings are briefly summarised and future avenues outlined.

1.3 Note on the Living lab concept

WP5 is mainly concerned with the notion of a *living lab* and how it can be understood in a public context. However, living lab as a concept is often juxtaposed with or related to *innovation lab*. In

literature, both living labs and innovation labs are seen as practice-driven concepts that emerged at the beginning of the millennium as ways of ensuring collaborative innovation in the public sector. However, the main distinction between the two concepts is their different antecedents, and that living labs have a broader application across sectors whereas innovation labs are sometimes concerned with either private, public or third sector contexts. Moreover, Schuurman and Tõnurist (2017) argue that innovation labs and living labs operate in different phases of the innovation process; innovation labs are seen as initiators of innovation and living labs as executors of innovation (Schuurman & Tõnurist, 2017). However, this is not consistent with all other understandings (cf. Björgvinsson et al. 2010; Copenhagen Living Lab & Public Intelligence, 2015; Nesti, 2017).

Due to the purpose of this report, we chose to emphasise the concept of living labs as it captures co-innovation and co-creation activities in a societal context (across sectors) better compared to the concept of innovation lab. Nevertheless, we have been aware of the interrelatedness between the two concepts throughout the study, both in joint discussions among partners, as a definition of search criteria, and in the final analysis. Thus, despite the main focus on living labs, initiatives labelled innovation labs have not been excluded from the review.

2 Methods

To map literature on, and experiments with, living labs across sources and partner countries different methods have been applied. The main task has been to 1) conduct a systematic literature review on research literature. But to make sure that the findings of the scientific literature review are backed up by empirical and context-specific insights and research initiatives, all partners have 2) contributed with a review of national and grey literature related to their home country besides a mapping of documentation of existing living lab initiatives relevant to the Co-VAL project. The systematic literature review is presented in section 3.1, the review of the national and grey literature is presented in section 3.2, and the mapping of living labs in section 3.3.

2.1 The systematic literature review

2.1.1 Data collection

In accordance with the PRISMA model (Moher et al. 2009), a systematic literature review has been carried out. Moher et al. (2009) provide a checklist for reporting a systematic review as well as a flow diagram for selecting the literature that has been used for this paper (see Figure 1 for details). The rationale for a review of this type is to map the literature, identify research issues and gaps and specify contributions and results in the literature. The search string applied was 'living lab' and the databases used were Scopus and Web of Sciences. The review revealed a distinction between living labs and innovation labs. Living labs were chosen as the main focal point due to their broader and more comprehensive approach to co-creation and co-innovation with users and other stakeholders, but literature on innovation labs was not excluded. An additional search was done in Google Scholar, and papers already identified in the development of the Co-VAL project description were also included. Searches were done on the following dates: Scopus: 06.02.2018, Google Scholar: 07.02.2018, Web of Science. 09.02.2018.

Since the two main foci were the key characteristics of what constitutes a living lab, that is, users and citizens as co-creators of innovation in a real-life setting, and how living labs might play a role in public service innovation, we excluded papers with a systems approach, e.g. urban planning, rural development and energy supply, papers focusing solely on private sector innovation, and papers that mainly focus on technology testing. The latter were excluded since the users are not actively participating in developing the innovation itself. However, we did include conceptual papers that integrated these aspects to distinguish them from other approaches. The included papers were empirical papers, as well as conceptual papers on living labs as approaches to innovation. All the included papers were concerned with citizen and/or user engagement in innovation, public service innovation, and drivers/actors of living labs. The exclusion criteria were studies on living labs that could not be said to target public service and public value explicitly or implicitly (e.g. living labs in a purely private context), and studies on living labs or innovation labs that were not based on citizen or user participation. Finally, some of the articles assessed for eligibility were not available to us. The studies included in the qualitative synthesis counts 52 articles. See the figure below for an overview of the review process.

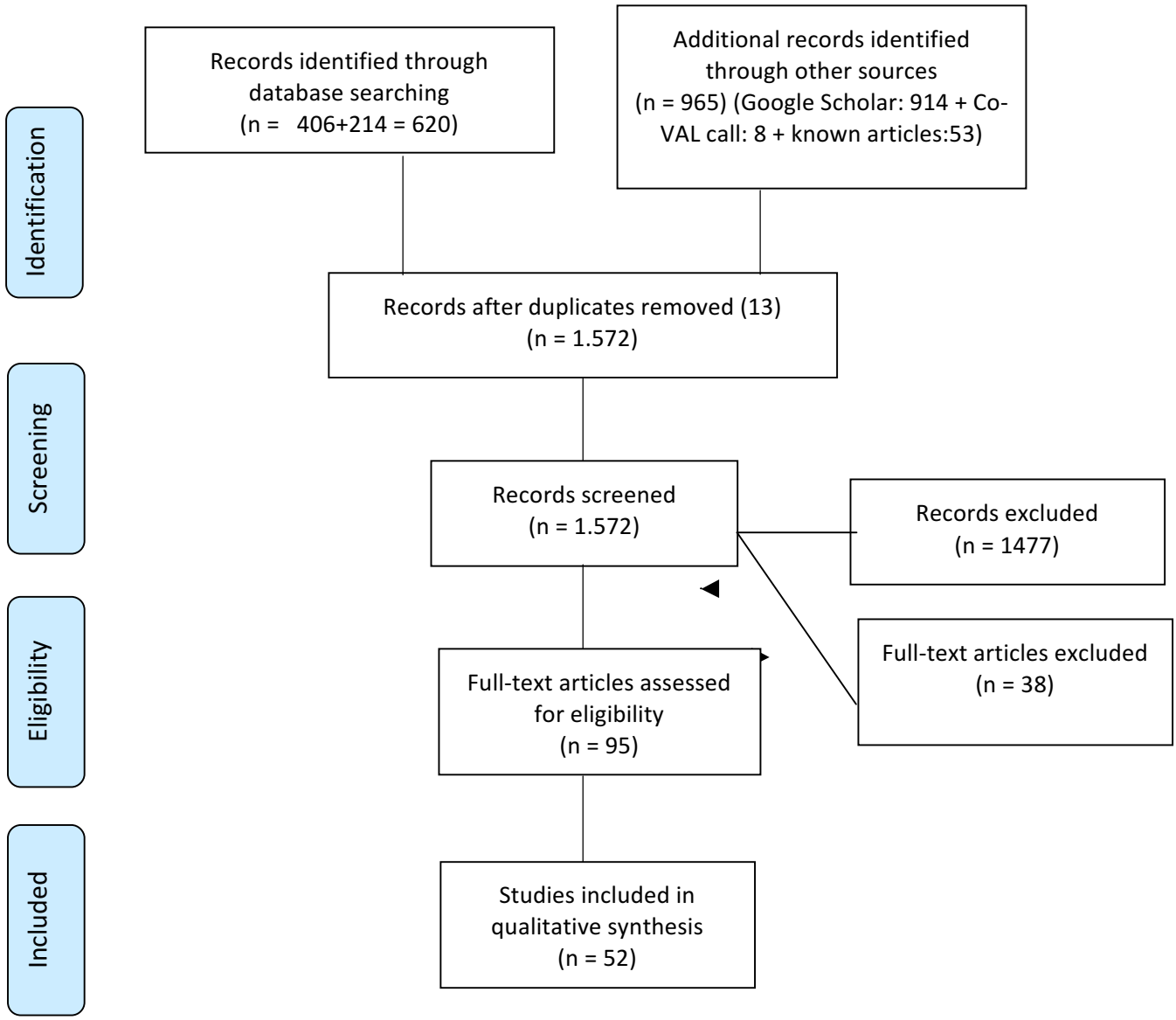

Figure 1: PRISMA Flow Diagram

2.1.2 Data analysis

We used an extraction sheet to collect information on the main content of each scientific paper, its main findings and themes. Based on this, we used a hermeneutical method to organise the papers into major themes. The coding of the themes was discussed between the two lead authors and subsequently reviewed by all partners. This led to a final list of main themes; see how these themes tie up to an overall model of living labs in Figure 2 (Section 4).

2.2 Review of national and grey literature

2.2.1 Data collection

To address national aspects of living lab perceptions and experiments, a review on research and grey literature in the national languages has been conducted by all partners. The selection criteria for this literature review were largely the same as for the scientific literature: We included empirical reports/papers, as well as conceptual reports/papers about living labs as approaches to co-creation and co-innovation. However, policy papers, strategy papers and innovation guidelines were also included, e.g. reports concerned with citizen and/or user engagement, public service innovation, and drivers/actors of living labs. The exclusion criteria were reports that could not be said to target public service and public value explicitly or implicitly, and studies that did not refer to citizen or user participation. As mentioned in section 2, this review is kept separate from the review of the scientific literature in order to investigate what living lab initiatives emerge from the national contexts of the partners, and thus how the research literature is backed by practical, context-specific insights and research initiatives in national contexts. Grey literature is defined as material which is **not formally published as research literature** and which might be produced by government departments or agencies, international agencies, local authorities, academic institutions, professional or scholarly associations, think tanks, charities, non-profit organisations, companies, and other organisations. Grey and national literature may include, but is not limited to, the following sorts of materials (https://libguides.rgu.ac.uk/greyliterature):

- reports
- working papers
- policy documents, guidelines
- discussion papers, briefings
- booklets, pamphlets, fact sheets
- conference, symposium or workshop papers or posters
- theses and dissertations

Moreover, we have included some research articles that present national cases which were not identified by or included in the systematic review. In total, a number of 88 materials have been identified (varying from each country). The records of grey literature consist mainly of theses, conference papers and reports. For an overview of the material, see Table 5.

2.2.2 Data analysis

The literature was analysed by means of an extraction sheet to describe each report/paper in terms of academic field, method, main theme, main concepts used, the definition of a living lab, geographical context, empirical/sector context, main findings, relation to co-creation and public value, and cases mentioned. The extraction sheet was used both as a quantitative meta-analysis of the documents and to explore some major themes in the literature across the different national contexts.

2.3 Identification of living lab initiatives

All partners have listed relevant living lab initiatives from either their partner country or from other known cases in Europe. In all, 70 cases have been identified. This material has been collected to provide a broader insight into current issues and perspectives of the living labs employed in the national contexts of the partners. The identification was based on an extraction sheet encompassing the following themes: project owner, organisation, sector, methods, timeframe, objectives, outputs, and relation to co-creation/public value. In this context, the list will be assessed as data material due to the detailed extraction sheet. Moreover, this gross list of living lab initiatives has been the outset for a subsequent case selection of case studies in work package 5.

3 Findings

In this section, the main findings of the study are presented. Firstly, we present the main insights derived from the three different reviews in separate sections and, subsequently, we present the summarised findings across the reviews.

3.1 The systematic literature review

The literature on living labs reveals that both the concept and the innovation approach are relatively new, which is why most of the literature stems from 2008 and onwards. Thus, it is not possible to detect temporal development in foci areas. Rather, the review exposes differing perceptions of what a living lab is, what a living lab does, who are engaged in living lab activities, and what living labs are the answer to, that is, to whom they provide value.

The main body of the literature applies the lingo characteristic of the research fields that have been looking into living labs, which are mainly tech-oriented innovation and urban studies. This sort of literature has been almost excluded in this final synthesis, with the exception of papers that maintain a focus on public service and citizen participation, alongside conceptual papers.

3.1.1 The notion of living labs in literature

The literature review shows that there are different ways of defining and conceptualising living labs related to the different research streams that have been part of the theorising on living labs. The notion of living labs has emerged mainly in the context of information and communication technology (Ballon et al., 2005; Eriksson et al., 2005; Følstad, 2008; Nesti, 2017), but also more generally in the area of services and public services, including health services (Gascó, 2017; Schuurman & Tõnurist, 2016; Tõnurist et al., 2017), as tools for co-creation and co-production of services (Nesti, 2017). Følstad (2008) has distinguished two perspectives on living labs: living labs as extensions to testbeds (testing of new technology, such as welfare technology) and living labs as context research founded in theories on users and society, such as science and technology studies (STS). Ballon and Schuurman (2015) argue that the approach to living labs that has evolved in a European setting has mostly followed the context research approach and is inspired by three other experimental approaches: Scandinavian co-operative design, European social experiments, and European digital cities. This also frames the prevalent differences in the final record, which based on the preliminary thematic analysis are (Table 1):

Context	Number of Living labs
Living labs as networks/ecosystems	10
Living labs as platforms for collaboration	8
Living labs as a methodology	7
Living labs as infrastructure	2
Living lab as open innovation	3
Living labs as territory (urban, national)	3

Living labs as a tech test bed	2
Living lab as ICT enabler	1
Living labs as bubble isolated from conventional systems	1
Living labs as a combined lab/household system	1
Conceptual papers with no specific definition	2
Articles with no definition	2

Table 1: Type of Living Lab contexts as described in the reviewed literature

As exposed in the table above, the main distinction in conceptualisations is between living labs as an innovation intermediary and living labs as a specific innovation method. On top of this, the record of articles can be divided into three main subgroups: living labs as methodology, living labs as a phenomenon, and the evaluation of living labs. In the following, we will further elaborate on these three overall approaches that will be the foundation for the forthcoming analytical themes of the review, including references.

1. The main part of the literature approaches living labs as a methodology of innovation based on empirical cases. Here, some literature analyses the cases as examples of open innovation or as innovation intermediaries, which as such enables and adds to a wider innovation ecosystem. In opposition to this system view, another stream of literature takes departure in studies at a microlevel, focusing on the organisation and management of living labs. This literature is concerned with managerial implications, the role of mediating actors, and the collaboration between researchers and practitioners. In addition to this internal focus regarding managing or facilitating living labs, the majority of the literature has the user and/or the citizen as its fore. The term citizen is mostly applied in papers that also apply terms such as participation and co-production, but in general, most papers are depicted by a design focus/lingo. In addition, the articles that apply the term *user-based* encompasses literature that either focus on the user's role in the innovation activities themselves, on living labs as outset for exploring user needs, or living labs as a mean for testing and evaluating digital platforms.

2. A vast amount of papers seeks to review and discuss living labs as a contemporary phenomenon. The main objectives are either to add an analytical concept or to engage in a conceptual clarification to the development of living labs. As in the literature in general, some focus on living labs as part of or enabling innovation ecosystems, whereas others dive into living labs as an innovation method. In the former string of literature, possibilities and limitations of conceptualising living labs as ecosystems are discussed. The latter string of research, that takes departure in living labs as an innovation method, especially discusses how living labs are socially organised. Across conceptual papers, the characteristic is that they are practice-based and hence more descriptive than meta-theoretical.

3. Few papers explore and discuss how the impact of living lab activities can be measured. There is no shared understanding of success criteria across papers, and the evaluation focus is still quite underdeveloped, which might be due to the newness of living labs, both in practice and in literature.

3.1.2 Living lab definitions

Within living lab literature there are a number of theorists that have set the scene when it comes to defining what living labs are. Most literature refers to either the definition by ENoLL; '*Living Labs (LLs) are defined as user-centred, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings*' (https://enoll.org/about-us/ August 1, 2018), or to some of the definitions exposed in the table below.

Source	Living lab definition
Eriksson et al. (2005)	"Living labs represents a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real-life contexts" (p. 4).
Ballon et al. (2005)	"An experimentation environment in which technology is given shape in real-life contexts and in which (end) users are considered 'co-producers'" (p. 3).
Ståhlbröst (2008)	"The concept of living lab can be interpreted and used as a human-centric research and development approach in which IC innovations are co-created, tested, and evaluated in open, collaborative, multi-contextual real-world settings" (p. 4).
Bergvall-Kåreborn & Ståhlbröst (2009) with reference to ENoLL, 2009)	"A living lab is an open innovation environment in real-life settings in which user-driven innovation is the co-creation process for new services, products and societal infrastructures. Living labs encompass societal and technological dimensions simultaneously in a business-citizens-government-academia partnership" (p. 357).
Feurstein et al. (2008)	"Living labs are collaborations of public-private-civic partnerships in which stakeholders co-create new products, services, businesses and technologies in real-life environments and virtual networks in multi-contextual spheres" (p. 2).
Følstad (2008)	"Living labs are environments for innovation and development where users are exposed to new ICT solutions in (semi) realistic contexts, as part of medium or long-term studies targeting evaluation of new ICT solutions and discovery of innovation opportunities" (p. 116).
Dutilleul et al. (2010)	"It may refer to (1) an innovation system consisting of organised and structured multi-disciplinary networks fostering interaction and collaboration, (2) in vivo monitoring of a 'living' social setting generally involving experimentation of a technology, (3) an approach for involving users in the product development process, or (4) organisations facilitating the network, maintaining and developing its technological infrastructure and offering relevant services; finally, the term may also refer to (5) the eponymous European movement" (p. 64).
Björgvinsson et al. (2012)	"…an open innovation milieu where new constellations, issues and ideas evolve from bottom-up long-term collaborations amongst diverse stakeholders" (p. 41).
Ballon & Schuurman (2015)	"Living labs typically refer to co-creation and appropriation of innovations by users, often in a (online or offline) community setting, and also involving business stakeholders. Over the years, multiple definitions of living labs have been proposed" (editorial).
Schuurman (2015)	"An organised approach (as opposed to an ad-hoc approach) to innovation consisting of real-life experimentation and active user involvement by means of different methods involving multiple stakeholders, as is implied in the Public-Private-People character of Living Labs" (p. 8 – a more complex definition is given on page 201-2).
Gascó (2017)	"Living labs can be understood as settings or environments for open innovation, which offer a collaborative platform for research, development, and experimentation in real-life contexts, based on specific methodologies and tools, and implemented through specific innovation projects and community-building activities. Living labs are driven by two main ideas: 1) involving users as co-creators of innovation outcomes on equal grounds with the rest of participants and 2) experimentation in real-world settings" (p. 91).
Nesti (2017)	"Living labs are both a physical space where, and a methodology through which, stakeholders,

	particularly users, participate in the development, testing and evaluation of a product or a service assisted by experts, using an open-driven approach to innovation" (p. 270).
Dekker et al. (2017)	"Living labs are a research and design methodology applied by research institutes in co-operation with public and private partners for developing and testing innovations in co-creation with users in real-life settings" (p. 14).

Table 2: A selection of living lab definitions

Looking at the definitions, there are slight differences in weighing of e.g. the experimental aspect of living labs, on ICT and technology development as primary or not and the use of partnerships over stakeholders. But in general, the living lab definitions are characterised by the notion of *users*, with *co-creation* or collaboration between diverse stakeholders and by being based in *real-life settings*. Co-creation mainly means co-creation of innovation rather than value co-creation. However, value co-creation is implied either as an effect of or a platform for co-creation of innovation. This furthermore implicates that living labs are based on a structured approach to innovation, which is more or less explicitly founded on the understanding of innovation processes as design, development, testing, and evaluation.

Despite the explicit focus on citizens and their role in designing for public services in a vast amount of the papers, at present, only Bergvall-Kåreborn and Ståhlbröst (2009) apply the term citizens in the definition of a living lab, and none of them are clear in regard to what sort of value is created and to whom. Also, there is no explicit focus on the public sector as more than an actor on the same terms as businesses and civil actors, and the pre-development phase is not taken into account in the presented definitions of living labs. Hence it is not clear who the actors are when it comes to identifying the challenges to be addressed. This also implicates that it is unclear how decision-making processes are to take place. However, the literature does discuss the need for pre-analysis, contextualisation, and pre-planning. In summary, this might indicate that current definitions do not fully embrace and encompass the many different forms of existing living lab practices, which is why a refined definition is proposed in the final synthesis of the review.

3.1.3 An overview of the literature

The reviewed literature is recent and contemporary. The earliest references date back to 2005 and the most recent are from 2018. Table 3 below provides a tentative overview of the main topics covered. The table suggests that there is a strong focus on conceptual work and methodology through case-studies and reviews, and only a few references explicitly focus on public governance. This suggests that the living lab approach is still an emerging field in general and specifically in the public context.

Participa-tory design /method-logy	Actor-network	Concep-tual/ mapping	Assess-ment/ learning oriented	Literature review	Survey/ Delphi	Case study (1-2)	Multiple cases	Explicit public gover-nance focus	Urban focus
xxxxxxxxxxx xxxxxxxxx	x	xxxxxxxxxxx xxxxxxxxxxx xx	xxxxxxxxxxx x	xxxxxxxxxx	xxx	xxxxxxxxxxx xxxxxxx	xxxxxxxxxxx xxxx	xxxxxx	xxxxxxxx

Table 3: : Tentative overview over the literature and its main focal points (each reviewed paper can cover several areas)

3.1.4 Themes in the literature

The main themes in the literature, based on our interpretations, are provided below. The coding of the themes is based on mutual discussions between the two lead authors of the report, and the results have moreover been reviewed and validated by the partners leading to a number of adjustments (hermeneutic approach).

3.1.4.1 Living lab frameworks

This subsection analyses how the literature depicts living labs as organisational frameworks. First, we analyse the varied dimensions of living labs that the literature speaks of. A typology (Table 4) is created based on these dimensions, which can be used as a sensitising device for positioning the literature and understanding the different dimensions of living labs and how they can be combined. Second, we analyse how the literature frames the boundaries of the living lab phenomenon vis-à-vis other innovation activities. Third, we provide an overview of the varied typologies of the living labs discussed in the literature. These typologies have been used to create a narrative of the living lab phenomenon. Finally, two applications of living labs for decision-making are described; living labs as a collaborative framework for changing goals and living labs as an ecosystem for policy innovation.

The dimensions of living labs

As already stated in section 3.1.2, no specific definitions of living labs are used consistently in the literature (see Table 2 for examples). Instead, the literature as a whole describes different dimensions of living labs. If we take the literature as a whole, it speaks of at least a) four different tasks that living labs can carry out, and b) three types of living lab environments. An overview of these dimensions is provided below. Table 4 seeks to combine the dimensions into an overall model of the literature.

a) The four identified tasks of living labs in the literature:

1. Exposing and/or appropriating opportunities for public service development. William Mitchell of the MIT MediaLab has been credited by several authors for coining the term living labs (Eriksson et al., 2005; Nesti, 2017). The MIT living labs were future homes where visitors were exposed to new technology in the realistic context of an artificial home. The living lab is thus referred to as a place where end users are exposed to and test new technology. The literature also describes living labs as spaces where innovations are appropriated by end users (Ballon & Schuurman, 2015). End users can explore the value and benefits of new technologies and services in a realistic environment. Thereby adapting innovations to the user context. An extension of this is the monitoring of a 'living' social setting (Dutilleul et al., 2010) such as a real home.

	Semi-realistic environment	Real-life environment	Network/community
Exposing and appropriating	"Living Labs are environments for innovation and development where users are exposed to new ICT solutions in (semi)realistic contexts" (Følstad, 2008).	"…in vivo monitoring of a 'living' social setting generally involving experimentation of a technology" (Dutilleul et al., 2010).	"Living labs typically refer to co-creation and appropriation of innovations by users, often in a (online or offline) community setting, and also involving business stakeholder"

			(Ballon & Schuurman, 2015).
Co-creating	"Innovation labs have thus far focused on the ideation and genesis stage of innovation, and then let go of the project afterwards (Schuurman and Tõnurist, 2017).	"Living labs are driven by two main ideas: 1) involving users as co-creators of innovation outcomes on equal grounds with the rest of participants and 2) experimentation in real-world settings" (Gascó, 2017).	"Living Labs are both a physical space where, and a methodology through which, stakeholders, particularly users, participate in the development, testing and evaluation of a product or a service assisted by experts, using an open-driven approach to innovation" (Nesti, 2017).
Co-researching	"MindLab's way of working is based on the laboratory idea, where new methods and approaches to strengthen citizen involvement – where possible across the three Ministries – are examined and the applicability of potential solutions is tested and developed" (Carstensen & Bason, 2012).	"Living labs are a research and design methodology applied by research institutes in cooperation with public and private partners for developing and testing innovations in co-creation with users in real-life settings" (Dekker et al., 2017).	"The concept of Living Lab can be interpreted and used as a human-centric research and development approach in which IC innovations are co-created, tested, and evaluated in open, collaborative, multi-contextual real-world settings" (Ståhlbröst, 2008).
Democratising			"…an open innovation milieu where new constellations, issues and ideas evolve from bottom-up long-term collaborations amongst diverse stakeholders" (Björgvinsson et al., 2012).

Table 4: Typology 1 – Tasks and types of living labs in the literature

2. Co-creating services with stakeholders. The literature generally focuses on co-creation of innovation rather than co-creation of value; hence emphasising the process over the outcome. Co-creation is about involving stakeholders, particularly end users in the innovation of technologies and services (Eriksson et al., 2005, Gascó, 2017). According to one paper, the European Commission started to support living labs as manifestations of user-centred approaches around 2006, as part of EU policies to improve European competitiveness and develop more effective innovation systems (Dutilleul et al. 2010). Through participation in living labs, user groups are meant to become involved in the development and testing of various outcomes, including new products, services, government and community systems, and new business models (Lahman et al. 2015). Much of the reviewed literature applies living labs to information and communication technology (Ballon et al. 2005; Eriksson et al. 2005; Følstad, 2008), which is why a source of inspiration is the Scandinavian co-operative design, which emerged in the 1970s as a method in working life science to involve employees (as users) in the design of new technology (Ballon and Schuurman 2015). Users can be employees as well as receivers of a service, but living labs are also described as broader frameworks than just user-centred. They might involve users as experts in service development together with other stakeholders. Ballon and Schuurman (2015) briefly describe stakeholders as technology providers, service providers, relevant institutional actors, professional or citizen end users. It implies that living labs often comprise public-

private-citizen interactions, but who these other stakeholders are and how they interact with users appear not to be specified in detail and is left open.

3. Co-researching with stakeholders. However, living labs are not just about co-creation amongst stakeholders, but also about researchers co-researching innovation with stakeholders. For example, according to Eriksson et al. (2005), living labs are "a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real-life contexts." It is stressed in several papers that researchers can be actively involved in living labs as initiators and facilitators of living labs (Gascó, 2017) since living labs are seen as researchable contexts for collaborative innovation. The living lab as a researchable context can vary in size and scope, ranging from a home, such as a nursing home, where new services and technologies are tested in a real-life context, to a city where new services are tried out by citizens.

4. Democratizing innovation. Some papers also see living labs in a context of democratisation. For example, Pelle Ehn and his colleagues refer to Malmö living lab as a project in which democratic, participatory design has been attempted (Björgvinsson et al. 2010). Their point of reference is Chantal Mouffe's (Mouffe 2000) agonistic approach in which many voices are engaged and empowered in a struggle for hegemony. The target of these living lab activities includes urban planning and planning of public services, and public services is explicitly stressed in some of the reviewed papers (cf. e.g. Gascó, 2017; Schuurman & Tõnurist 2016; Tõnurist et al. 2017; Gatta et al. 2017). Living labs are here generally described as methods and platforms for the development of, and experimentation with, public services (Gascó 2017) and/or services in an urban planning context (e.g. Gatta et al. 2017). Some element of democracy (in the sense of direct user involvement) is implicit in these understandings, as they represent new types of direct citizen involvement, which is different from representative democracy. However, it is not very clear how democracy is framed.

b) The types of living labs environments in the literature:

The literature speaks of at least three types of living lab environments, which are summarised below.

1. Semi-realistic environments ('labs', 'showrooms'). Some authors describe living labs as extensions to testbeds (or showrooms) where new technology or new services can be tested or explored by involving end users (cf. Følstad, 2008), or as 'innovation labs', i.e. 'safe spaces' for experimenting with new solutions (Carstensen and Bason, 2013). The innovation lab approach that we find in the literature (Carstensen and Bason, 2013; Schuurman and Tõnurist, 2017) stresses that the lab is not real life but somehow derived from a real-life context. They provide a space for creative thinking in the initial stages of innovation, thereby also removing some of the risk and pressure from the real-life context of public services. Semi-realistic environments are as close as we come to a traditional scientific lab. However, they are not scientific labs, but experimental open settings that involve end users.

2) Real-life environment (singular focus). Generally, most of the literature refers to living labs as real-life environments for innovation activity (Gascó, 2017; Eriksson, 2005; Ståhlbröst, 2008). Living labs are thus supposed to have a high degree of realism "offering the most realistic environment possible

to allow 'sense-making' processes to take place through experiential learning leading to better understanding of product/service adoption behaviours by users" (Lehman et al. 2015, p. 1093). There is almost agreement in the literature that living labs are to be understood as real-life settings, hereof the 'living' in the living lab (Schuurman & Tõnurist 2017; Følstad, 2008). They are seen as research-based design contexts (Lehman, 2015; Gascó, 2017) that involve researchers to collect knowledge from the living experience. However, what this means is somewhat blurred. It appears mostly as an experimental environment which is close to the real environment of the end users. Many of these entities also appear to have a singular focus on specific predefined service areas such as elderly care.

3) Networks, communities (bridging perspectives of relevant actors). Much of the recent literature stresses that living labs are related to networks or communities that involve many stakeholders. However, this does not suggest that living labs are networks, rather they are activities or spaces embedded in network structures. Gascó (2017) stresses that living labs can be seen as intermediary organisations (following Howels, 1996), hence a kind of change agent that goes between the user and the provider to enable innovation. It is a special kind of intermediary that institutes an open collaborative platform for research, development, and experimentation (Gascó, 2017, p. 91).
Leminen et al. (2017) argue that a new generation type of living lab can be identified that underlines the broader environment of innovation and the varied roles of the stakeholders. Slightly different wordings are used, such as: ecosystem (Gascó, 2017), open innovation network (Leminen et al. 2012), platform (Leminen et al. 2017), public open innovation intermediaries (Gascó, 2017), innovation systems and in vivo experimental settings (Dutilleul et al., 2010), a dynamic environment built to test project solutions in real-life contexts (Gatta et al. 2017), knowledge systems (Lehman et al., 2015), or multi-stakeholder organisation (Schuurman & Tõnurist, 2017).

There is some disagreement concerning the phase of innovation that living labs aim to cover: whether it is the initial, explorative stage of innovation (Lehman et al. 2015) or the later stages of development and implementation. Some of the most thorough descriptions of living lab methodology tend to focus on the initial stages of innovation (cf. Ståhlbröst, 2008). However, other authors stress that living labs might also target the implementation context for innovations (Schuurman and Tõnurist, 2017).

Living labs can thus be framed in many ways. There may be a tendency in the literature to move from living labs as showrooms/innovation labs towards living labs as embedded in a network, and from exposing and appropriating to co-creating and co-researching. There are only a few studies that take democratisation as a starting point.

Table 4 provides a map of the different dimensions and their combinations. It is suggested that the different approaches of the map may in practice be combined in different ways depending on the context and purpose of the living lab.

The boundaries of living labs
Given the many and broad definitions of living labs that we find in the literature, it becomes challenging to draw the exact boundaries around the living lab phenomenon vis-à-vis other innovation activities.

Overall, the living labs are described as specific contexts for innovation. Even if they are framed as real-life environments (the 'living' part of living labs), they are in fact specific experimental spaces or settings (the 'lab' part) that enable some degree of experimentation with innovation in a 'safe space'. Hence while they are creative and innovative units that draw on and combine everyday experience from real life, they are also specific settings and activities that remove pressure, risks and ethical concerns of innovation from the true real-life context of public administration. The value of the living lab context is drawn from the balanced combination of these two characteristics.

The literature makes some further distinctions that are useful for tentatively drawing the boundaries of the living lab phenomenon. However, there is no agreement in the literature about this, which suggests that the living lab approach is often contextually defined and emerged from practice.

For one thing, the literature distinguishes living labs from 'scientific labs' – and this is perhaps a common idea. Thus, Eriksson et al. (2005) make a fundamental distinction between the traditional scientific lab and the living lab. The traditional lab is seen as a single, controlled experimental context. A living lab is, by contrast, a multiple and emerging experimental context. Schuurman and Tõnurist (2017) argue for a distinction between 'innovation lab' and living labs. While the innovation lab focuses on the initial stages of an innovation process and involves cross-disciplinary teams, the living lab concept targets development and real-life experimentation and is a multi-stakeholder organisation. However, there is no agreement in the literature about this. Part of the literature applies living labs to the initial stages of creativity, idea-generation, and innovation (cf. Ståhlbröst, 2008) while other parts focus on testing of innovations at the later stages.

Living labs are compared to other experimental innovation frameworks, yet the boundaries between these seem to be somewhat blurred. Some attempts are made to distinguish these phenomena. Ballon et al. (2005) distinguish between 6 types of tests and experimentation platforms (observed in the area of broadband innovation): (1) prototyping platforms (including usability labs, software development environments), (2) testbeds, (3) field trials, (4) living labs, (5) market pilots, and (6) societal pilots. They are all platforms that pull together various stakeholders in the innovation processes. However, they represent initiatives at different stages in the innovation and design process from low market maturity and prototyping to high maturity and societal impact. The living lab is a stage in between representing "an experimentation environment in which technology is given shape in real-life contexts and in which (end) users are considered 'co-producers'" (p. 3). Based on a number of qualitative cases of each type, it is shown that living labs score relatively high on six chosen parameters: openness, public involvement, commercial maturity, vertical scope (integrating the value chain), scale, and duration.

Følstad (2008), based on a literature review, identifies two 'emerging trends' of living labs which is widely referred to in the literature: 1) living labs as context research and co-creation, and 2) living labs as extensions to testbeds. Contrary to Ballon et al. (2005) who argue that testbeds and living labs are distinct phenomena, Følstad (2008) argue that they are merging. Living lab as context research and co-creation represents research on how technologies and services emerge in practical contexts during their adoption and use. This includes STS-like (Science and Technology Studies) research (such as ethnographic research) as well as more action-oriented research on user involvement, including

research on democratisation of innovation. Testbeds and technical testing are applicable in the later stages of an innovation process where users give feedback to providers about usability issues. Technical testing can be combined with context research. It appears, however, to be an unresolved question in the literature whether and how testbeds and technical testing should be counted as living labs.

Typologies of living labs

We have already discussed the different main dimensions of the living labs described in the literature. However, the literature discusses different typologies of living labs. This suggests that the literature seeks to open up the concept and include many types of activities in the living lab phenomenon. Hence the living lab phenomenon is a complex concept that can be interpreted in many ways and pull together diverse supporters in different environments, generally suggesting the need for varied experimental settings and safe spaces for stakeholder involvement in innovation. The risk of broadening the concept in this way is that the living lab concept becomes difficult to recognise and institutionalise. However, typologies are useful for creating a narrative of the evolution of the living lab phenomenon and its identity.

Leminen et al. (2012) argue that four types of living labs can be distinguished. This typology is referred to in several articles. The four types are distinguished by the actors who drive them, which are: user-driven labs, enabler-driven labs, provider-driven labs, and utiliser-driven living labs. User-driven labs are said to be driven by people meant to be using a given technology or service, provider-driven labs are driven by research institutions and universities, enabler-driven labs are driven by government and other actors representing the public sector, and utiliser-driven labs are driven by companies using living labs as a test facility for their products. Many of the examples given in the literature appear to be provider- and/or enabler-driven. We find fewer examples of user-driven labs as understood above.

Schurmann et al. (2013) referred to in Angelini et al. (2016) suggest a different typology of four living labs: (1) American living labs, (2) testbed-like living labs, (3) living labs focused on intense user co-creation, and (4) living labs as mainly facilitators for multi-stakeholder collaboration and knowledge sharing. The advantage of this categorisation compared to the one proposed by Leminen et al. (2012) is arguably that this typology does not exclude that a lab can be driven by different actor groups simultaneously. The American lab is understood as a regular home inhabited by volunteer researchers testing new technology. The testbed is the 'extension to testbed'-version mentioned by Følstad (2008) which includes a real-world validation of testbed results. The co-creation living lab includes co-creation of new ICT-services and collection of data on the usage context using ethnographic approaches. The multi-stakeholder living lab is focused on multi-stakeholder collaboration and knowledge sharing, with less emphasis on developing and testing new technologies or end user involvement.

Leminen et al. (2017) argue that a third generation type of living labs can be identified. The first generation of living labs was real-life environments with stakeholder participation. The second generation of living labs was research focusing on the varied methods and methodologies used in living labs. The third generation supposedly underlines the broader environment of innovation and the varied roles of stakeholders. Thus, in an urban living lab, stakeholders can be catalysts, rapid

experimenters, providers and neighbourhood participators (Leminen et al., 2017). They define third generation living labs as "platforms with shared resources, which organise their stakeholders into a collaboration network(s), that relies on representative governance, participation, open-standards, and diverse activities and methods to gather, create, communicate, and deliver new knowledge, validated solutions, professional development, and social impact in real-life contexts." (Leminen et al., 2017, p. 22).

Finally, Leminen and Westerlund (2017) draw on distinctions from the innovation and service literature between linearised and iterative innovation processes, and between customised and standardised tools. This enables them to distinguish four archetypes of living labs. These are named: linearisers, iterators, mass customizers, and tailors. Leminen and Westerlund (2017) further argue that using standardised tools in a linear innovation process will usually lead to predefined incremental innovations. By contrast, iterative innovation processes combined with customised tools will increase peoples' passion in living lab activities and increase the likelihood of an undefined and a novel innovation outcome.

Living labs as a collaborative framework for changing perceptions and goals

The literature describes various applications of living labs to decision-making. Two examples are living labs as a collaborative framework for changing perceptions and goals and living labs as an ecosystem for policy innovation. We deal with the first in this section and the other in the following section.

Living labs can involve a change in mindset and goals as expressed in one paper on public sector innovation labs (Carstensen & Bason, 2012). Carstensen and Bason (2012) report the important story of the Danish Mindlab (2002-2018) – a cross-governmental innovation lab involving public sector organisations, citizens and businesses in creating new solutions for society. They argue that innovation labs are designed to foster collaboration since labs are platforms where multiple stakeholders can engage in interaction, dialogue, and development activities. According to the authors, Mindlab intends to create a home and safe space for a systematic approach to innovation particularly emphasising the exploration of new solutions. Innovation needs a different approach than everyday activities and a change in mindset and culture shift of employees towards thinking more systematically about innovation. Mindlab's methodologies are anchored in design thinking, qualitative research and policy development, with the aim of capturing the subjective reality experienced by both citizens and businesses in the development of new solutions. Carstensen and Bason (2012) list the following key principles of Mindlab: take charge of on-going renewal, maintain top management backing, create professional empathy, insist on collaboration, do – don't just think, recruit and develop likeable people, don't be too big, communicate.

Also, Buhr et al. (2016) show how living labs can be important for developing and implementing collective goals and to create new opportunities for public influence of citizens. They describe two cases in two suburban areas (located in Sweden and Finland), where the living lab approach was used to improve the feeling of belonging in a community. In one of the two suburbs studied, a living lab approach was used to change the lightning on a partway that seemed unsafe; and in the other case, a living lab approach was used to strengthen the social community by renovating a kiosk and organising varied activities for the citizens. Both living labs motivated the residents to work on societal goals for

sustainability and choose solutions. The study indicates that a living lab approach can be used for gaining support for change and thereby increase the citizens' appreciation of a local area. Further, living labs may give citizens a feeling that they are being listened to. Living labs can thus create opportunities for citizens to develop the city together with municipal policy-makers and other stakeholders and enable policy-makers to respond to the expressed needs of the citizens.

An ecosystem for policy innovation
Living labs are also seen to be part of a wider ecosystem of policy innovation, which is difficult to linearise and control; citizens have varied capacities for participating and stakeholders, such as small firms or employees in the public sector, may lack resources or time for participating. Moreover, there may be insufficient institutional support for interaction and innovation within a living lab and in a wider societal context.

Van der Graaf and Veeckman (2014) conducted a case study analysis in the city of Ghent of a living lab that invited citizens to participate in the development of mobile services to access data from the city. While they found that public services can be co-designed together with citizens, they also found that the toolkits had to be aligned with citizens capacities. They conceptualise this as a dynamic co-creation ecosystem in which citizens may participate depending on their capacity to participate. The study indicated varieties of citizen participation by highlighting differences in the creative capacity of citizens and in the contributions they were able to make, guided by the provided design hub.

However, a living lab may also contribute to changing an ecosystem by influencing the local governance structure. Reiter et al. (2014) take a governance perspective on living labs. They argue that the governance challenge related to living labs is to empower citizens' role in governance through participation in living labs. Living labs can help repair 'innovation system failures' (they report a case of environmental governance) such as insufficient interaction between stakeholders, missing or inadequate institution for innovation and path dependency, i.e. the tendency of the actors to stay within the existing paradigm of innovation. Thus, a living lab introduces new ways of innovating by creating an institutional context where stakeholders can interact in order to develop innovations. Yet, the challenges of the living labs are; to get stakeholders to take an interest in the local context of governance, to define a governance purpose, i.e. define a "common goal", and to find a way to sustain the local governance.

Hence living labs have been investigated as related to the governance structure and ecosystem of a local community as they are understood to empower and motivate citizens to participate in innovation activities and decision-making. But still, living labs must struggle to mobilise citizens who have different capacities and motivations to participate.

3.1.4.2 Practices of living labs/organising

Practices of living labs
Many of the presented studies tend to take a normative approach to living labs; they present living labs as solutions to problems in a positive way as something good rather than investigating them

more critically, including the biases they entail. Some papers who also describe the historical development of living labs tend to present the most recent frameworks as the most relevant. However, we also know from some studies that living labs may tend to be short-lived because they compete with other more mainstream activities and tend to lose legitimacy. Others have stressed the lack of enthusiasm when these activities become too standardised and too linear. Thus, there is a need to adopt a more practice-oriented perspective on living labs in order to understand how they are intertwined with and sustained by everyday practices. There are several studies that go in this direction, pointing to the different elements of living lab practices that pose challenges to the involved actors.

Work practice. Kanstrup (2017) explores the work practice of living labs *as* carried out in eight living labs in elderly care homes by the people living and working in the labs, which includes the residents, employees and management at the care homes. The study demonstrates that the work of the people living and working in labs is critical to the success of living labs and recommends attention to work balance, user gains and collaborative innovation in living lab theories and methods. Kanstrup finds a gap between what was intended and what happened; collaborative innovation activities turned out to be either a low priority or not a priority at all. Moreover, there appeared to not be sufficient focus on the knowledge and experience it takes to collaborate about innovation as well as the work balance of the people living and working in the lab.

Role patterns. Another way in which the literature describes the practice of living labs is through the lens of role patterns. Nyström et al. (2014) have attempted to *s*tudy actor roles and role patterns in living labs. They identify ten new network roles of actors in living labs (in addition to the seven that have previously been mentioned in the literature). By examining the role-sets and behaviour of the network actors, the study found that there are four patterns that are characteristic of living labs: role ambidexterity, role reciprocity, role temporality, and role multiplicity.

Work tasks. Hakkarainen and Hyysalo (2016) seek to capture the work tasks of user-based innovation in a four-year living-lab project. Their approach starts from a science and technology studies approach using concepts like domestication, infusion and social learning, as well as the literature on innovation intermediaries to understand how technologies are adapted in a local context. Living labs are seen as co-design infrastructures in which the users' creativity around technology and their efforts to fit technology to cultural, organisational, and material contexts become resources for product development (Hakkarainen and Hyysalo, 2016, p. 46). It is concluded that intermediation work in a living lab project is not just about facilitation. It also includes configuring of technology and the use of practices, brokering contacts and interactions between different actors besides facilitating their work, learning, and interactions. Thus, intermediary work continuously evolves during a living lab project; 13 intermediary activities with 31 tasks were identified.

Willingness to carry out practice. Hyysalo and Hakkarainen (2014) conducted a comparative analysis of two innovation projects in elderly care, floor monitoring and wrist monitoring – the first came to be organised as a living lab and the second not. Both cases had to go through a redesign process in order for the technology to work in a user-context. The authors argue that extensive collaboration between designers and users is vital for the success of health technology projects. The living lab approach speeded up the redesign process that both projects experienced. However, this could be achieved

without a formal living lab arrangement, albeit such an arrangement does appear to help in achieving it. A living lab, as such, appears to be no panacea for collaborative design efforts between designers and users. The crucial point is rather 'whether the parties engaged in living lab collaboration are willing to go through all the work needed to create the specific and particular relationships by which the relevant information can be made visible and transferred to the other party' (Hyysalo & Hakkarainen, 2014, p. 206).

Living lab as a partial and flexible object. Hesseldal and Kayser (2016), based on actor-network theory, explore a healthcare living lab called Epital (created in a Danish municipality but isolated from the conventional health care system). They name the promoters of the lab the Epitalist following the actor-network tradition of treating them as a tribe. The paper conceptualises the living lab as a 'bubble' and as a 'partial and flexible object that constitutes multiple future possibilities'. The authors argue that the living lab emerges in a political process that takes place between the existing (inside) and the alternative (outside) environment. Actors that work in the laboratory also work outside the laboratory to promote its role. The ability to leap between inside and outside is crucial for maintaining the lab. The Epitalists have to build a political network. Based on Bruno Latour's approach, the authors suggest considering laboratories as places where society and politics are renewed and transformed. They also argue that if a laboratory intends to be disruptive, strong alliances must be built with other stakeholders. If it is more aligned with the existing (formal) and the alternative (informal) systems, it may be easier to accept the laboratory as a normalisation process/evolution.

By focusing more on the practice of living labs, the above papers introduce an empirically grounded and critical discussion of activities that unfold in and around the living labs understood as a social and political construct. They provide a contextual, practice-based understanding of the messy reality of living labs and see the living labs as continuously changing multiple objects.

3.1.4.3 Interaction with users/citizens

Conceptualising interaction

Interaction among diverse stakeholders is a key feature in living lab literature, implicating that most articles are based on empirical cases depicted by public-private-people-partnerships (Edwards-Schachter et al. 2012; Nyström et al. 2014; Äyvaäri & Jyrämä, 2017; Schliwa & McCormick 2016; Cascó, 2016). This type of partnerships is by some conceptualised as the four P's, by others as a quadruple helix and lastly, some do not apply such categorisation but still refer to cross-sectorial collaboration. In sum, most living lab cases rely on the interaction between business, research, public administration and civil society/users. In addition, part of the literature takes empirical cases from *within* the public sector as a point of departure (Carstensen & Bason, 2012; Buhr et al. 2016; Hakkarainen & Hyysalo, 2016). These cases might integrate various stakeholders, but they do not rely on distinct partnerships where the decision-making power is sought to be distributed among all actors engaged. On the contrary, they present co-creation activities initiated by the public sector, and hence with the public sector itself as a main beneficiary.

Across these overall understandings of interaction, most literature maintains a specific focus on the end user/citizen as vital, but the approach to interaction nevertheless influences whether the focus is mainly on end users *or* citizens. When the focus is on the public sphere, the cases are often depicted by addressing overall societal challenges, e.g. sustainability, governance or policy development. In this case, living labs are seen as enablers of an 'equally' distributed decision-making power (Steen & Van Bueren, 2017) or of democratic engagement by including the voice of the citizen (Björgvinsson et al. 2012). Governance seen from a Foucauldian perspective is also present, which is why some authors argue that living labs should challenge the prevailing market-oriented discourse on innovation and hence the current hegemonic innovation practices; which they understand as being based on a neoliberal logic (Björgvinsson et al. 2012; Cardullo et al. 2018).

In contrast to this, authors focusing on the partnering aspects of living labs are less concerned with societal challenges as such and are more concerned with e.g. managerial implications of interaction/co-creation and living labs as open innovation ecosystems (Äyvaäri & Jyrämä, 2017; Pino et al. 2014). These research streams are concerned with developing (public) services and products and seem more focused on the notion of the user, not applying the term citizens. This is also the case in articles that take the public sphere as a point of departure, where the citizen is basically approached as an end user (Keijzer-Broers et al. 2015; Pino et al. 2014). These differences will be further explored in the following.

Degree of user/citizen interaction

Across literature and research streams on living labs, a core concept when defining living labs is co-creation. But still, what constitutes co-creation, i.e. who are part of the co- and what is in fact created is quite blurry. One of the most precise definitions of the concept is put forward by Björgvinsson, Ehn and Hilgrenn (2012): '*This acknowledges co-creation as a collective interweaving of people, object and processes'* Björgvinsson et al. 2012, p. 130). Another aspect of co-creation, emphasised by Dell'Era and Landoni (2014), is the *awareness* of users – meaning that the user is aware of their own role in co-creation since they are explicitly invited into the development process (Dell'Era & Landoni, 2014, p. 147). In addition, there are differing perceptions of the degree to which the user/citizen is involved in living lab activities/innovation processes. We interpret this as a continuum where we at one end see a collective view that emphasises democratic ideals based on creating rooms for discussion and debates among various groups of people, ensuring a polyphony of voices to be heard (Björgvinsson et al. 2012; Cardullo et al. 2018). While we see a more individualistic view at the other end that emphasises the subjective needs of the actors involved (Äyvaäri & Jyrämä, 2017; Edwards-Schachter et al. 2012). As such, the user/citizen is approached as co-creator among other actors also invited into the innovation process. Dell'Era and Landoni (2014) refer to these different approaches as either an expert mindset or a participatory mindset. In the former users are seen as subjects, i.e. *reactive* informants, whereas in the latter users are seen as partners, i.e. *active* co-creators (Dell'Era & Landoni, 2014, p. 148).

The differences in the actor roles mentioned above are also mirrored in the terminology applied in the included literature regarding interaction. To exemplify, research stemming from a design tradition frequently refers to the term participation (Dell'Era & Landoni, 2014; Björgvinsson et al. 2012), whereas research based in geography and urban studies often refer to collaborative arenas (Schliwa & McCormick, 2016; Steen & Van Bueren, 2017), and finally, research based in a technological tradition

mainly uses the notion of open innovation (Keijzer-Broers et al. 2015). What seems to be mixed up is the application of user-centred, user-centric, user-based, user-oriented and user-led, which is not explicitly defined or accounted for in literature; there seems to be no common ground as when to apply what concept and often they are juxtaposed and used interchangeably. A note here is that the notion of infrastructure (as a foundation for innovation), when it comes to understanding user/citizen involvement, is understood differently; infrastructure through design lenses, i.e. infrastructur*ing*, means an on-going alignment of contexts, whereas infrastructure in most other literature is understood as the fundamental elements and systems for innovation projects and activities to occur.

3.1.4.4 Innovation as process or outcome

The perception of innovation in living lab literature is broad. In papers where living labs are seen as innovation infrastructure in a design perspective, the phases towards a specific outcome become less evident due to the more process-oriented and on-going nature of the innovation processes living labs are meant to support (Björgvinsson et al. 2012). In these articles, the citizens/users are therefore ideally engaged in the whole innovation process. When living labs are seen as testbeds or as co-creation methodology, the role of the users in different innovation phases become clearer. Here, users or citizens are invited into the development process either in idea generation or as evaluators of a given technology or social initiative when the service or product developed is to be refined (Edwards-Schachter et al. 2012; Keijzer-Broers et al. 2015). As such, living labs become part of a wider innovation ecosystem where different actors can engage in innovation activities and projects.

In the cases where the main aim of living labs is seen as platforms for democratic engagement, as described above, the notion of innovation is more specifically oriented towards social innovation (Edwards-Schachter et al. 2012). The reason might be twofold: that the research stems from a design tradition that is inherently development-oriented, which is why innovation is not widely applied as a concept, and that the focus is more on the process as a game changer itself than on a specific outcome (Björgvinsson et al. 2012).

Across the approaches to innovation processes, even when the citizen and/or user to some degree have decision-making power, they do not seem to be part of the initial early innovation stages where challenges are identified. This leads to another aspect that seems to differ in literature: that the perception of interaction, of the main actors' role and on innovation processes also influence what the raison d´être of living labs is. From the collective perspective, the continuous democratic contestation and discussion among actors are what living labs should support. As such, the objective of living lab activities is to be a space for democratic engagement, making the main beneficiaries the citizens themselves – due to the possibility of getting a legitimate voice. Furthermore, authors based in urban studies see living labs as a means to address e.g. sustainability and wider societal challenges, implicating that the main beneficiary is society at large. Literature that focuses on living labs as innovation methodology or innovation intermediaries seem to think of innovation, as not just a means, but rather as the main outcome itself. Hence the key beneficiaries are the actors involved in living lab activities – but mainly the initiators. To better understand these differences, the notion of institutional boundaries by Schliwa and McCormick (2016) can be applied. They draw upon the mentioned categories from Leminen et al. (2012) to define the main boundaries in case studies of

living labs in Europe; utiliser-driven (e.g. companies), enabler-driven (e.g. municipalities), provider-driven (e.g. universities), and user-driven (e.g. citizen) (Schliwa & McCormick, 2016, p. 172). Thus, the institutional boundaries themselves might influence what is perceived as the objective, and hence the outcome, of living labs – be that as an arena for democratic engagement or a specific collaborative approach to innovation.

3.1.4.5 Living lab methodologies

When looking into living lab methodologies, it becomes clear that part of the literature is concerned with the specific methods applied, while others put more weight on the innovation process itself and management thereof. Accordingly, some papers pinpoint that adjusting and fitting is a crucial part of living lab practices and conditions. Therefore, the following subthemes will structure this section: *Methodological approaches* and *Adjustment as a living lab characteristic.*

Methodological approaches applied by living labs

Most living labs are researched as either single or multiple case-studies (Dekker et al. 2017, pp. 39-42), and mixed methods seem to prevail: qualitative interviewing, focus groups and observations coupled with data logging and surveys (Dekker et al. 2017, p. 39; Liedtke et al. 2012, p. 109). To exemplify, Ståhlbröst and Holst (2017) give an account of an innovation process focused on energy tech testing where the technology was tested in the homes of end users, followed up by individual interviews and subsequently focus group interviews (Ståhlbröst & Holst, 2017, pp. 29-30). Other examples are the application of expert panels, shadowing, observations, and conducting workshops (Angelini et al. 2016; Liedtke et al. 2012). Also, it seems that the experimental nature of living labs allows for highly iterative innovation processes. A point in this regard is that some authors see living labs as transdisciplinary platforms and hence the transdisciplinary approach is to be seen as a methodological innovation itself. The assumption is that when resources from different professions are released, it is possible to address the heterogeneity of complex social challenges (Angelini et al. 2016). In accordance, most argue that the contribution of living labs is the not the distinctive methods per se, but rather the way they are combined in novel ways (Dekker et al. 2017; Angelini et al. 2016).

From a more overall perspective, Almirall, Lee and Wareham (2012) argue for living labs as 'a mechanism for innovation' specifically positioned in user-based innovation processes. Based on empirical studies of four living labs across Europe, all part of ENoLL, the authors map different innovation processes which they see as representative of widespread practices in the living lab landscape. The shared characteristics are closely related to what we see in the prevailing definitions of the living labs presented earlier: that identifying and integrating user needs is part of the iterative co-creation process, that living labs operate in real-life contexts understood as arenas of meaning-making, which forms the ecosystem in which these user needs are detected and analysed, and where, finally, public-private partnerships are a foundation for the involvement of multiple stakeholders (Almirall et al. 2012, p. 16). Dell'Era and Landoni (2014) also see living labs as a platform for participatory design processes rather than as *a* method in itself, and slightly similarly, Ståhlbröst and Holst (2017), taking a process perspective, emphasise that the co-creational aspect of living labs is the approach itself. That is, living labs are characterised by co-creation *as* an innovation process and not merely co-creation *of* an innovation (Ståhlbröst & Holst, 2017). As has become clear, it is difficult to

map living lab methods and methodologies figuratively since the distinct process is either not exposed in literature or because the link between certain methods and living lab approaches is not clear cut.

Adjustment as a living lab characteristic

Based on the shared understanding that living labs are characterised by user-centricity and open innovation, some authors pinpoint that the implication regarding management and operationalisation is the ability to adjust both roles and actions according to the specific living lab context. Almirall, Lee and Wareham (2012) claim that living lab methodology is especially suitable when a distinct technology/service relying on user feedback and acceptance is to be tested and/or when a specific user group is to be addressed. Hence, they argue that living labs are beneficial when there is a double-sided focus on both user needs (tacit and known) and the integration/validation of these in service or product innovation (Almirall et al. 2012, p. 18). Focusing on management, Ståhlbröst and Holst (2017) add to this by arguing for reflexivity as a core competency among managers. This is due to the complex and dynamic nature of living labs besides living labs being catalysts for innovation – which entails inherently unknown aspects and outcomes. Reflexivity is thus seen as a foundation for managing living labs, but also as a basis for learning among both managers and end users (Ståhlbröst & Holst, 2017, p. 32). From a design perspective, Dell'Era and Landoni (2014), in the same vein, state that living lab methodology implies the competence to be able to facilitate co-creation processes that are highly contextual, and hence the designer/manager needs capabilities in stakeholder interaction and in adjusting to local settings (Dell'Era & Landoni, 2014, p. 152). Franz (2015) adds to this by pinpointing the crucial aspect of recruiting participants for living lab activities/initiatives (Franz, 2015). She underscores the importance of an on-going dialogue between managers/researchers to ensure that the most active community members/users are not represented over the e.g. marginalised. Moreover, she suggests that living labs, when focusing on social innovation, need to be adjusted in regard to the terminology applied (herein dismissing the notion of actors), contextualisation of methods and outcomes, and increased reflections and flexibility towards the different phases of interaction between participants and researchers (Franz, 2015, p. 57).

If we are to sum up the above, living lab methodologies are based on traditional case study research with an overweight of qualitative methods. The newness of the living lab approach is therefore seen as the application of these in real-life settings with a specific focus on end users. As such living lab methodology becomes either an open innovation method or a distinct process that is especially context-sensitive in regard to actors involved, management applied, and the contexts in which the process or outcome are enacted/outplayed.

3.1.4.6 Assessment and legitimacy of living labs

The literature on evaluation is limited and only a few papers explore and discuss how the impact of living lab activities can be measured. But, in supplement there are papers that either explicitly or implicitly are concerned with the legitimacy of living labs, their raison d´être and herein the strengths and weaknesses of living labs. Thus, this section is divided into two sub-themes: *The legitimacy of living labs* and *Living lab impact assessment*.

The legitimacy of living labs

In the following, we present two overall views on what the constitutive conditions for living labs are and how this relates to their legitimacy. Firstly, we see a critical view, primarily based on literature on smart cities and citizen engagement. Cardullo, Kitchin and Di Feliciantonio (2018) argue that living labs exemplify inherent tensions in social processes based on a neo-liberal logic. On the one hand, living labs propose a space and platform for experimental approaches to participation and engagement. The authors emphasise that living lab initiatives can support trust building among participants and enable long-term investment (at least in the smart city perspective), giving various actors the opportunity to participate (Cardullo et al. 2018, p. 49). However, they also stress that living labs often rely on fiery souls and activists already active in the community and as such release existing resources. On the other hand, the authors claim that living labs risk reinforcing the discourse of the 'creative economy' and by doing so contribute to the exclusion and displacement of specific citizen groups. Moreover, they pinpoint, in the same vein as other researchers, that within living lab initiatives, citizens are seldom engaged and the question of civil rights is not addressed (Cardullo et al. 2018, p. 49). More downplayed, other authors also pinpoint that, especially when living labs initiatives are targeting vulnerable citizen groups, ethical and legal issues should be integrated and addressed (Franz, 2015; Pino et al. 2014), while others question whether the living lab framework in reality brings something new to the table. As mentioned earlier, based on a comparative study of two innovation projects within health care, one framed as a living lab and one not, Hyysalo and Hakkarainen (2014) conclude that the project set up as a living lab was depicted by the same opportunities and challenges as the project not set up as a living lab. Therefore, they argue that extensive collaboration and co-creation does not necessarily need to be formalised as a living lab, even though living labs still offer a legitimate rationale for collaboration based on the Quadruple Helix approach – which they perceive as a legitimising metaphor (Hyysalo & Hakkarainen, 2014, p. 206).

This critical view is not widespread since most literature focuses on living labs as a new way of co-innovating public services, based on e.g. the notion that living labs are *tools* for co-production (Nesti, 2017). Since Nesti applies a narrower understanding of living labs as merely an innovation methodology, she argues that the potential lies in the ability to integrate user insight into policy processes, while also stressing that living labs are low-cost innovation experiments. When it comes to weaknesses, some authors, again in opposition to Cardullo et al., (2018), underscore the short-lived aspects of living labs – both regarding constrained funding, political support and lack of proper business models (Nesti, 2017, p. 279; Pino et al. 2014, 259). This is backed up by Tõnurist, Kattel and Lember (2017), who also see a high mortality rate presumably due to loss of political legitimacy and conflicting organisational structures. According to Tõnurist, Kattel and Lember (2017) innovation labs are fluid and semi-autonomous, seen as answers to complex issues, herein economic crisis and democratic challenges (Tõnurist, et al. 2017, p. 1473). Therefore, innovation labs are seen as catalysts for legitimising change within the public sector – by their potential as change agents. Hence, the strengths are related to the possibility of creating new organisational forms, while the weaknesses of living labs are related to resistance and lack of sustainable organising. But despite these pitfalls, pinpointed by the authors referred to, none profoundly questions the legitimacy of living labs as a new and fruitful approach to public sector innovation.

Living lab impact assessment

In the literature, it seems that evaluation criteria and impact measurement are applied almost interchangeably. However, they address the same issue: that due to the heterogeneous and practice/context-dependent nature of living labs, the evaluation had seemed difficult. Furthermore, due to the high degree of 'mortality' of living lab initiatives, the time has come to refine the evaluation criteria for securing sustainable living labs prospectively (Ballon et al. 2018).

Focusing on impact, Ballon, Van Hoed and Schuurman (2018) give one of the most recent overviews of conceptual usage, evaluation methods and approaches to impact assessment within the field of living lab literature. They pinpoint how literature that goes beyond describing living lab practices and living lab as a phenomenon has now emerged – but also, that the number of articles on impact and evaluation is still scarce. Ballon, Van Hoed and Schuurman (2018) identify different approaches that outline what living labs can be evaluated upon, e.g. value, sustainability, influence, realism, and openness (see Ståhlbröst, 2012). Some focus solely on the outcome and results of specific projects and others argue for evaluating the following three levels: living labs as an environment, living lab as an approach and living labs at a meso-level, i.e. the concrete living lab projects (see Schuurman et al. 2016). Ballon, Van Hoed and Schuurman add to these perspectives by proposing a set of guidelines as conditions for monitoring living lab effects. Their proposal is based on internal parameters, self-reporting and an urge to strive for uniformity by agreeing upon working definitions and the creation of a logical effect model (Ballon et al. 2018, p. 13).

At a more systemic level, Mastelic, Sahakian and Bonazzi (2015) analyse the existing evaluation criteria from current ENoLL Living lab evaluation, the living labs themselves. They argue that the following key elements are missing: identification of cost structure, customer segments, and revenue streams. Based on the Business Model Canvas logic they pinpoint that to make living labs more sustainable, strategic reflections on how the living lab network can develop, who the main active actors are and which member profiles should be invited are needed (Mastelic et al. 2015, p. 22). Furthermore, they add temporal aspects as highly relevant if the evaluation is to embrace progression over time. This process perspective is also reflected in other papers that take the living lab itself as a point of departure. In regard to measuring the impact of living labs, Schliwa and McCormick (2016) identify three main types of impact based on the *output* of living lab initiatives: direct impact, indirect impact, and diffuse impact. Direct impact refers to tangible outcomes from within the project/initiative, seen from both an economic, ecological and social perspective. Indirect impact refers to the spin-off of living lab activities, such as policy recommendations and/or knowledge transfer to the market and society. Finally, diffuse impact refers to a more profound change in normative and cultural value within society, a change that can transition the understanding and the approach to the societal problems themselves (Schliwa & McCormick, 2016, p. 173).

In sum, most literature exposes a rather traditional view on evaluation focusing on effects that can be measured by the end of the initiative – as opposed to systemic evaluation that is much more iterative in nature, inviting the evaluator in as part of the process/initiative from the beginning. Moreover, the evaluation focus still seems quite underdeveloped, implicating that most articles on evaluation, strength and weaknesses and impact of living labs are characterised by either presenting very contextual parameters taking a specific case as a point of departure or generic parameters based on a systemic view. As Ballon, Van Hoed and Schuurman state: impact assessment of living labs has until

present remained anecdotal (Ballon et al. 2018, p. 5). This is supplemented by an awareness that it is in fact hard to know or detect if outcomes reached by the living labs approach could have been realised without this framing/set-up. Thus, a future avenue could be to find a third way that outlines both evaluation parameters across living lab sectors (based on the main characteristics of living labs), contextual factors (based on the specific empirical case in focus), and the four bottom-lines (democratic value, effect/quality, innovation, and societal value).

3.1.5 Summary

In the following, we firstly sum up the main findings of the literature review, and subsequently, we present some more critical reflections on the implication of these findings. The bullet points below provide a partial answer to our research question (see also the concluding section – section 4): *How are living labs currently used and conceptualised in scientific research and practice, and how does this influence opportunities and limitations regarding value creation and the role of citizens in co-innovation?*

Based on the systematic review we see the following main findings:

- Living labs are presented as organisational contexts for co-creation of technologies and services in an experimental and realistic setting.
- Living labs have been supported by the European Commission since 2006 as part of EU-policies to strengthen European competitiveness.
- Living labs have emerged in the context of ICT but have spread to other areas in public services, including health services.
- No specific definitions of living labs are used consistently in the literature.
- Living labs are in literature understood as public-private-people-partnerships – referred to as either the four P's or Quadruple Helix, since living labs involve many stakeholders that are affected by the changing practices in the development of new practices.
- Co-creation is understood as the engagement of various actors at different phases in the innovation processes.
- Living labs appear to have similarities with other experimental innovation frameworks (e.g. participatory design) and the boundaries between them seem to be somewhat blurred.
- Two types of living labs have been identified (Følstad, 2008, p. 1): living labs as context research and co-creation and 2) living labs as extensions to testbeds.
- Another referred distinction is between user-driven labs, enabler-driven labs, provider-driven labs and utiliser-driven living labs (Leminen et al. 2012).
- Living labs are also seen to be part of a wider ecosystem of policy innovation and as a platform for change rather than as a methodology.
- The outcome of living lab activities is understood to be new products, services or environments. However, it can also be a change in mindset.
- Many of the presented studies tend to take a normative approach to living labs since they positively present living labs as solutions to specific identified problems, while a few studies more critically seek to understand how living labs are intertwined with and sustained by everyday practices if at all.

- Living labs are either seen as a specific open innovation method or as a platform for combining existing innovation methods in novel ways. Hence the ability to make contextual adjustments is perceived as key in managing living labs.
- The legitimacy of living labs is discussed from the two main perspectives: one partly based on critical theory and one focusing on co-production and co-innovation. The latter is the most prevalent.

Critical perspectives for further research:

- Most articles apply a certain definition of a living lab, which is then often challenged by the empirical findings. In this manner, there seems to be a gap between theory and practice in the sense that the definitions become ideal descriptions of living labs as *should/could* be and not necessarily *as is*.
- The main characteristics of a living lab, that is, real-life setting and user co-creation include multiple definitions.
- It is conceptually unclear how co-creation and user participation is in fact organised and users/citizens often seem not to have strong decision-making power.
- The pre-development phase of innovation is seldom taken into account.
- The outcome and impact of living labs, either implicit or explicit, is almost absent, leaving it vague how living labs intend to add to the public sphere and public value.
- There is an acknowledged lack of living lab impact studies.

The above findings will act as a point of departure for the forthcoming typologies and moreover as an outline for the future research section.

3.2 Review of grey literature

3.2.1 Method

In order to investigate how the scientific knowledge above is backed up by practical context-specific insights and research initiatives, a selection of national theoretical, empirical and grey literature is reviewed in this section. This review is separated from the scientific review in order to provide insights on what emerged from the national contexts of policy and research. Therefore, each partner involved in WP5 provided a survey of national theoretical, empirical and 'grey literature' on living labs. We looked for grey literature according to the definition of grey literature provided on https://libguides.rgu.ac.uk/greyliterature. The partners used local search databases, Google and Google Scholar to search for the national publications using the search word 'living lab' and related search words that were feasible in the national context. For each publication deemed relevant, the partners filled in an extraction sheet and provided information to the following topics (when possible): document name, year of publication, academic field/discipline, method, main theme, main concepts used, definition of living lab, geographical context, empirical context/sector context, main findings/contributions, relation to co-creation and public value, and cases mentioned. The extraction sheets are appended to this report.

3.2.2 Characteristics of the publications

As can be seen in Table 5, most of the publications that surfaced during the search were published in the period from 2013–2018. Some partners were able to identify significantly more reports than others, but the number of publications is not dependent on country size. Hence the German partner was only able to identify four reports while the Danish partner identified 13. This may reflect the fact that the living lab concept and method has not been used much in Germany, while it has played a more prominent role in Danish public sector innovation activities.

Partner/ Year	nd	05	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
Roskilde University (DK)					1	2			2		2	3	3			**13**
Universidad de Alcala (SP)							2			2		1	1	2	1	**9**
Universite des Sciences et Technologies de Lille (FR)						1	1	1	1	5	1	1	3	7	4	**25**
Høgskolen i Innlandet (N)		1			1	1					1				2	**6**
The Lisbon Council (B)	1							1		3	8	6	4	3	1	**27**
PriceWaterhouseCoopers (I)								1			2		1			**4**
Universitat Konstanz (D)										1			1	1	1	**4**
Total	**1**	**1**			**2**	**4**	**3**	**3**	**3**	**11**	**14**	**11**	**13**	**13**	**9**	**88**

Table 5: Overview over number of reports reported by partners and year of publication

In Table 6 (below), we can see that most publications identified are related to research. A relatively large proportion of the publications are research articles, papers in proceedings and doctoral theses. Thus, seven doctoral theses have been identified that deal with the topic of living lab. This may suggest that living lab activities to a large extent are linked to research efforts or are researcher driven. However, we also find a diverse set of reports written by public or private sector actors in government, government agencies, and private consulting firms. Living lab activities are thus not merely driven by researcher practices but impacts a diverse set of actors that facilitate and organise living lab activities. No regulative documents were identified (1 white book though) and thus living labs appear to be poorly institutionalised.

Type of publication	Number
Research articles	36
Reports	19
Book chapters	3
Papers in proceedings	10
Working papers	2
Doctoral theses	7
Master's thesis	1
Bachelor's thesis	1
Book review	1
Communications	3
Documentation	1
Policy document	1
Project eHealthnet ebook	1
Speech	1
White book	1
Total	**88**

Table 6: Type of publications

It was possible to identify academic disciplines (Table 7) or fields for all reports, which shows the importance of academic practices in the design of living lab activities. Most of the research fields are multidisciplinary, problem-oriented and represent various efforts of applied or solution-oriented research, innovation and knowledge-building efforts in areas such as public innovation, health care, design and anthropology, and many more.

Academic fields	
Anthropology	Management of public services
Applied economics	Multidisciplinary / innovation
Communication studies, innovation, ICT design	Open innovation
Consultancy oriented research	Policy research.
Consumer research	Public innovation
Design science	Public-Private Partnership
Educational research, technological literacy research	Regional Science
egovernment	Rural development, urban development, community development, citizen participation
eHealth	Sciences and technical fields for the well-being of society
Energy	Smart cities
Energy/ environment / social science	Smart Cities and sustainable urban development, living labs
Engineering and innovation	Smart city and sustainable development
Geography, economy and planning	Social affairs but pluridisciplinary approach
Health services, co-creation	Social innovation
ICT design	Sustainability research
Impact assessment/evaluation	Technology of architecture
Information society, open innovation	Urban planning
Innovation and technology management	Urbotics
Innovation Policies	User-centred innovation
Living lab research	
Management	

Table 7: Academic fields represented in publications

There is a broad international coverage in the reports, as can be seen in Table 8. The survey mainly focused on national literature from partner countries (Belgium, Denmark, Germany, France, Italy, Norway, and Spain), which explains the bias towards these countries. However, some additional publications were uncovered from Canada (in French by the French partner). Other countries are also represented as national literature contains comparative materials, for example, a cross-country comparison of living lab activities. To exemplify, a Danish report may also include experiences from Sweden or Iceland, and an Italian report may draw upon experiences from Slovenia. Some reports also have a wider European and/or international coverage. This shows that living lab activities, as a method to configure new technology and service practices, is an international/European/EU-related phenomenon. Practitioners and researchers collaborate across countries and draw experiences from each other, which also suggests that rather than being highly institutionalised at a national level, living lab activities are being explored and boosted at an international level.

Country	Number
Africa	1
Austria	2
Belgium	6
Canada	4
Cyprus	1

Czech Republic	1
Denmark	12
Europe	5
Finland	2
France	18
Germany	2
Greece	2
Hungary	1
Iceland	1
International	4
Italy	19
Lithuania	1
Norway	4
Slovenia	1
South Africa	1
Spain	10
Sweden	1
Switzerland	1
The Netherlands	1
USA	1

Table 8: Empirical context partly or completely focused (country)

Concerning the types of methodologies that have been used in the publications, it can be noted that case studies and conceptual papers dominate. We also find a few significant examples of handbooks and guidelines. However, looking at these, there is no consensus on how a living lab or living lab activities should be run. There are similarities across the cases, but each publication also appears either as explorative, seeking to gather information about living lab activities, or as a unique and highly contextual approach to living labs. This can be seen both as a strength and a weakness in the landscape of living labs. It means that the living lab phenomenon has multiple shapes and can be adapted to many different contexts. This can also be a weakness because it is difficult to outline the contribution of living labs in a precise way. Many conceptualise living labs as a form of user-centric experimentation with innovative solutions in a real-life or (semi) realistic setting. However, this type of definition takes its starting point in users. Yet the concept of users may cause confusion; what is a user and what is being used? It might have been more relevant to downplay or entirely avoid this concept and instead emphasise the concept of 'practice' and 'stakeholders' as a starting point since living labs appear to be about designing practices for stakeholders.

Main type of method applied	Number
Case studies	44
Conceptual papers	13
Desk research	6
Ethnographic, interviews and observations	5
Development of handbook, guidelines, manifesto, methodology	4
Literature reviews	3
Policy documents	3
Surveys	2

Descriptive studies	2
Experiments	2
Dialogue	1
Cluster analysis	1
Web design	1
SWOT analysis	1
Total	**88**

Table 9: Main types of methods in the reported documents

3.2.3 Major themes in the publications

The publications show a wide diversity of themes and concerns. Living lab activities are explained as manifestations of user-centric solutions to innovation in technologies and services. As such, they contribute to creating a competitive environment for firms, improving the ability of the public sector to innovate and potentially creating a more democratic environment for innovation. At the same time, a concern is expressed that living labs are poorly institutionalised and poorly anchored in communities and therefore not always fit for purpose. The concept of a user is not entirely clear because service 'practices' (of providers and those that use them) appears to be the target of living labs rather than user-involvement in innovation as such.

Developing the key principles

Several publications attempt to outline the key principles of a living lab stressing their role for 'user'-centred innovation. A few examples are provided in the following. Tchékémian and Richard (2013) define living labs as an open environment of full-scale innovation, where users participate in the creation of new services, products, and societal infrastructure. Copenhagen Living Lab and Public Intelligence (2015) describe living labs as an organisational manifestation of the concept of 'design thinking' or user-driven innovation and discusses which parts of the development and innovation process the living lab contributes to, such as design and implementation.

Ståhlbröst and Holst (2012) develop a methodology of living labs labelled FormIT: It is inspired by soft systems thinking, appreciative inquiry, and 'needfinding'. It consists of three iterative cycles: concept design, prototype design, and innovation design. The report defines living labs as both an environment (milieu, arena) and an approach (methodology, innovation approach). In a living Lab, the aim is to accomplish a quadruple helix by harmonising the innovation process among four main stakeholders: companies, users, public organisations and researchers. Thus, living lab environments should have a good relation, and access, to users willing to be involved in innovation processes.

Other publications have a more explorative approach to living labs. Von Geibler et al. (2017) summarise a research project the goal of which was to find out how living labs can be used for future sustainable consumption and production in work and living environments of individuals. Hess et al. (2017) describe the internal process of living labs and provide methods and strategies for user and citizen participation. Mérindol and Versailles (2016) compare eleven open innovation laboratories (IOLs) in nine major French companies in order to analyse their missions, the role of employees, their relationship to the rest of the company and identify their key success factors. Deutscher Bundestag (2018) lists and describes living lab projects in the following European countries: Denmark, Germany, Finland, France, Great Britain, Norway, Austria, Portugal, Sweden, and Spain.

Particular areas

Several publications explore particular areas where living labs have been applied, particularly in healthcare. For example, Bygholm and Kanstrup (2014) explore the use of intelligent beds in a nursing home through a living lab approach. Kanstrup (2008) presents ongoing work on development and experiments in a Living Laboratory for ICT health services in the city of Skagen in Denmark. Nielsby and Gustafsson (2015) have been testing sensory screens at three nursing homes using a living lab approach. In this case, both employee and user practices are focused; the importance of the screen for stimulating the demented citizen and for the staff's work routines, as well as the general experience of implementing technology in the organisation are discussed. Korsnes (2017) also focuses on a particular living lab showing that the Trondheim living lab offers a unique opportunity to better understand the way in which stakeholder engagement and co-production have been attempted through two avenues: the living lab and prosumption. The paper reviews these two concepts and provides lessons learned on how co-production and engagement can be achieved successfully.

The use of ICT is often at the centre of the living lab approach. Alatriste (2015) analyses the application of a living lab methodology in the design of eHealth systems with the purpose of enhancing user experience. Ferrari et al. (2011) describe the living lab PPPP (Public/Private/People Partnership) pursued by 'Trentino as a Lab' (TasLab), an initiative promoted by the Autonomous Province of Trento, Italy, whereby the creation of new ICT services, products and social infrastructures is enhanced by user-driven, open innovation principles and practices.

Smart cities, territorial development and social innovation

Part of the literature focuses on the link between smart cities, territorial development and social innovation. Ferraris and Santoro (2014) look into the concept of social innovation and its role in smart city projects. Concilio et al. (2011) look at territorial dimensions of living labs in peripheral regions of Europe. Berloco (2014) develops a concept of smart cities as places allowing citizens to collaborate directly with the designers, thus becoming ‘co-developers’ of new products or services intended for themselves. This also includes projects of electronic business and electronic commerce. Further, a goal is to raise the general technological level to create a stimulating environment for high-tech companies.

Alcotra Innovation (2013) develops a living lab analysis to improve the shift from research to innovation with users in the frame of EU policies of smart specialisation. They provide an analysis of cross-border cases to improve competitiveness and diffuse the living lab approach for social innovation and development in rural areas. Hammerl et al. (2016) analyse how living labs can be used for urban development using two case studies of living labs in Austria. Furthermore, the potential for living labs as a way to enhance citizen participation is evaluated. Klein and Pecqueur (2017) see the living lab strategy as an emerging form of organisational innovation that questions traditional practices and modalities of action in territorial development.

Living labs as third places

The notion of a ‘third place’ has evolved especially in the French language literature (‘tiers-lieux’). Scaillerez and Tremblay (2017) suggest that third places (fab labs, coworking places, living labs) are booming within the OECD countries. The article is an international review of the literature about those themes. According to Besson (2017), the notion of a third place covers multiple realities such as

coworking spaces, living labs and fab labs. Relying on open innovation methods and the digital potential, the article questions the role and scope of third places in the fabrication of contemporary cities, which would also be co-produced with inhabitants.

Capdevila (2015) explores how collective creativity plays an important role in the innovative processes of organisations. Many open innovation spaces (Fab Labs, hackerspaces, makerspaces, coworking spaces, living labs, etc.) are based on openness, collaboration and knowledge sharing, but differ in their entrepreneurial approach. Roux and Marron (2017) state that livings labs propose new ways of thinking about public action in the development of territories. These devices are part of the metropolitan dynamic, but they are still rarely used by public authorities.

Fernández (2016) asks to what extent living labs are ideal spaces where four main features of knowledge and information society, according to the Italian urbanist D. Siena, are met, namely: a) self-organisation; b) open innovation; c) social "appropriation" of ICTs, and d) horizontal participation. Thus, the notions of living labs as a special place or space both have idealistic connotations of a ‘safe space’ were people can experiment with innovations, and as something which sometimes may be decoupled from practices of people by being only a semi-realistic space.

Evaluation and assessment
A few publications underline the need for assessment and evaluation of living labs. Winthereik et al. (2017) argue that there is a need for reflection on how the users are actually involved in the innovation process, how they are chosen and how this selective representation reflects back on the particular user group. They intend to deconstruct the essentialist image of the user and product that is currently being reproduced in the living lab environment. This indicates that the concept of a user is not unproblematic.

Ballon et al. (2018) show that there is a lack of impact assessment and evaluation in living lab activity. They look for varied qualitative and other ways to demonstrate the value of living labs, discuss the methodological problems of multiple causality, and attribution versus contribution approaches to evaluation. Further, they test a specific qualitative-quantitative tool on a case study of 14 living lab projects based on self-reporting, focusing on inputs, activities, objectives and outputs. The authors show that it is highly complex to assess the impact of living lab activities because it is difficult to attribute specific results to a living lab. Generally, one can conclude that the living lab literature is struggling to outline what exactly living lab activities contribute to changing practices.

3.2.4 Summary

This summary provides a partial answer to our research question: *How are living labs currently used and conceptualised in scientific research and practice, and how does this influence opportunities and limitations regarding value creation and the role of citizens in co-innovation?*

The national theoretical, empirical and 'grey literature’ on living labs is quite diverse in terms of geographical context, type of publications, methods applied, academic fields, and themes. Many of the publications are case-oriented, but we also find more general reviews of living lab activities and

guidelines rooted in particular methodological principles. The specificity of living labs appears to be its focus of user-centric experimentation with innovation in a real-life setting. However, the concept of the user is tricky; the presented examples of living labs refer to a great variety of different users in many different contexts, and the people involved are not users but rather practitioners or stakeholders. Living labs are also described as 'third spaces' that are not always well-integrated with community developments and practices.

There is no consensus in the publications on how exactly living labs should be defined as an environment and methodology. Most examples of living lab activities reported in the publications appear to be poorly institutionalised in the context of the public sector, i.e. temporary projects with high mortality rates. Finally, there is little emphasis on the evaluation of living lab activities. Impact assessment is shown to be complex due to multiple causality and should therefore both evaluate the contributions of living labs to stakeholders qualitatively, as well as using more quantitative measures to understand how living labs affect the process and outcomes of innovation activities. However, the living lab literature is struggling to outline what living lab activities contribute to changing practices of co-creation and co-innovation. We identified four main themes in the literature that sought for an answer to these questions without reaching a clear conclusion: Developing key principles of living labs, research on particular areas where living labs have been applied, living labs as third places for innovation and co-creation, and evaluation and assessment.

3.3 Identification of living lab initiatives

As mentioned in the methodology section, all partners have listed relevant living lab initiatives from either their partner country or from other known cases in Europe. The identification, and hence the listing, was based on an extraction sheet encompassing the following themes: project owner, organisation, sector, methods, timeframe, objectives, outputs and relation to co-creation/public value. In this context, the list (extraction sheet) will be assessed as data material due to its degree of detail. The gross list consists of 70 living labs initiatives more or less equally distributed across 13 European countries (see table below).

Country	Number of relevant Living labs
Austria	3
Germany	3
Estonia	1
Spain	8
Denmark	9
Sweden	2
Norway	9
United Kingdom	6
The Netherlands	3

France	12
Italy	9
Czech Republic	1
Belgium	4

Table 10: Living lab overview

Since the extraction sheet was based on fixed themes, the short forthcoming analysis is not to be seen as a mapping of the living lab landscape in each country, but rather as an analysis of similarities and variations across the entire list. Also, during the mapping, it became clear that the main distinctions are not related to geographical areas but merely to the public domains addressed and the actors involved in the included initiatives. The analysis of the extraction sheet is structured around three overall themes: Insights on organising, Approach to co-creation, and Value creation.

3.3.1 Insights on organising

Most initiatives are from 2002 and onwards, with a main group of either projects or established labs that have only been running since 2012 (a number of 30). 28 out of the 70 identified living labs did not expose their start date, but these were mostly the ones from private sector labs. The majority of the identified living lab initiatives are on-going, leaving only a few with a fixed expiry date. Moreover, most living labs are owned and/or initiated by public sector actors. This can both be at a governmental or municipal level or by research communities. In addition, there are examples of private sector labs targeting public value by facilitating the development of the public administration and of civil society initiatives based on network structures that more broadly address societal challenges.

In relation to the understanding of what a living lab is, all the initiatives on the list share the traits (at least idealistically) of a living lab: they work with open innovation, they focus on end users and most are involving actors from different sectors. Thus, a vast amount of the initiatives is based on collaboration among academia, private companies and public administration. Nevertheless, a few seem to be based on direct collaboration with citizens, since the citizens are rather invited *into* living lab activities and act less as drivers of development or as decision-makers. Moreover, the real-life aspect is not clearly defined, so it seems like it is merely a way to conceptualise methods that involve end users, employees or stakeholders and not necessarily refers back to the context of the user.

The living labs run by large consultancy firms such as PWC, Deloitte, KPMG, and Accenture deviate from the other initiatives on the list as they have been generally targeting more businesses but have now a growing interest in providing offerings to the public sector. Despite a shared methodological approach, they are inherently concerned with a dual process of value creation: developing sustainable business models while as contractors to the public sector supporting public value creation.

3.3.2 Approach to co-creation

Across the identified living lab initiatives, it is possible to distinguish between two central approaches to the co-creational activities of living labs: co-creation for developing and testing technology or co-creation focusing on developing and adapting methods for co-creation itself.

This distinction seems related to the kind of service offering that the development is supposed to target, i.e. welfare broadly, specific public service offerings or overall societal challenges. In this manner, it is possible to differentiate between both domains and type of service. To exemplify, based on data: elderly care is a domain depicted by both relationship building and rehabilitation, energy supply is focused on sustainability and environmental challenges, and the public administration are mainly developing digital services. There is a focus on technology testing and testbed environments to a large degree across the domains – but with slight differences in approach to co-creation. The development of digital services in the public administration, herein cyber security, is characterised by IT development tools such as SCRUM, agile methods and design thinking. Whereas design thinking seems to prevail throughout the initiatives, the development of welfare services that are not digital from the outset is depicted by a huge variety of co-creation methods – that seem to be adapted to the service offering under development or the context. Living labs that are based on the notion of being a space or place for interaction seem especially method agnostic. Despite differences, the methods for co-creation activities seem fairly similar, but the difference lies in what the methods are supposed to support: development of a product/service or a process.

3.3.3 Value creation

In continuation of the above, the question of what kind of value is created can be divided into direct or indirect value, which again is dependent on whether the initiative targets the public sector, the public administration specifically or the general public.

Direct public value can be both at an infrastructure level or an individual level. E.g. initiatives focusing on rural and/or city development have a wider perspective on societal challenges such as energy supply, lightning etc. in general and as such, they address public value in a broad sense – but directly in the sense that the public is affected. The initiatives targeting welfare focusing on vulnerable groups of citizens and the elderly seem to understand the value created as the possibility of mobilising these actors in society, and as such, they seek to create direct public value to the citizens involved.

Indirect value is especially apparent in the development of tools to *do* public administration since it is about making the administration itself more efficient. Indirect public value can also be related to the nature of the public service, e.g. military or national security. Also, the living lab initiatives targeting the private sector fall into this category – based on the understanding that developing businesses bring value to the public by either becoming qualified sub-contractors to the public sector or as drivers for development in general.

3.3.4 Summary

The summary provides a partial answer to our research question: *How are living labs currently used and conceptualised in scientific research and practice, and how does this influence opportunities and limitations regarding value creation and the role of citizens in co-innovation?*

In sum, the analysis of the identified living lab initiatives seems aligned with the main findings from the systematic and the grey literature reviews. Firstly, the emergence of living labs as a new phenomenon and the perceived main characteristics of living labs are mirrored in the list, i.e. user-focused, open innovation method/platform and cross-sectorial collaboration. Secondly, a flexible and adaptable application of a variety of co-creation methods seem to prevail, and the identified distinction between a focus on the innovation outcome or the innovation process itself as a game changer is also apparent in the listed living lab initiatives. Finally, the list of living lab initiatives exposes that who the key actors are, herein initiators, and which public service domain is in focus have implications on the overall objective and hence to the perception of what kind of value is created: indirect or direct public value.

3.4 Typologies and redefinition of living labs

A main finding in the literature review is that the concept and usage of living labs are diverse and to some extent blurred, making it hard to detect and expose concrete streams of thoughts and their implications. This is already illustrated by typology 1 (Table 4). Typology 2 (Table 11) is developed on the basis of the review and is merely to be seen as mapping existing knowledge that can act as a point of departure for the case studies of the work package. The typology below (Table 11) shows what the concept of living lab refers back to exposed via the main continuums identified, and one that reveals different types of co-creation processes.

Contextuality	Small scale – large scale
Innovation outcome	Product/service/processes – the process/living lab in itself
Co-creation approaches	Individualistic (user as informants) – Collective (users as active partners)
Methods	Technology testing – ethnographic studies
Value	Value to society at large – value to a specific user group
Living lab definitions	An ecosystem for innovation – an open innovation method
Raison d'être	A platform for democratic engagement – a tool for co-creation
Time frame	Short-lived – long-term change agents regarding societal challenges

Table 11: Typology 2 – Living lab continuums

Based on the above, we propose a refined definition of living labs as they are understood and operate today. The aim is to come up with a definition that reflects the notion of living labs as a contemporary phenomenon exposed in literature rather than adding another idealistic definition.

"*Living lab is a conceptualisation of multi-contextual and cross-sectorial experimental user-centric innovation processes with the aim of developing and/or improving welfare products, democratic*

engagement, services or processes based on the application of co-creation methodologies depicted by transdisciplinarity"

The main difference from the prevailing living lab definitions in literature is that the notion of real-life setting and the strong emphasis on the end user/citizen is left out. Since these two aspects are continuously contested in literature – the meaning of real-life is either blurred, or it is not clear how e.g. users have a more distinct role than other stakeholders. Instead, it is emphasised that the current main characteristics are 1) an openness towards deliberately experimenting 2) disparities in settings, and 3) involvement of various actors are simultaneously present.

3.5 Future research

The literature review shows several characteristics and knowledge gaps in the literature that outline avenues for future research. Firstly, no specific definitions of living labs are used consistently in the literature. Living labs appear to have similarities with other experimental innovation frameworks (e.g. participatory design), but the boundaries between them seem to be somewhat blurred and need to be specified. Secondly, the concept of the user as co-creator often seems vague as living labs refer to a great variety of different users in several different contexts. Consequently, current living lab activities involve the design of many specific practices, and the people involved are not only end users but are better conceptualised as stakeholders or practitioners. Thirdly, living labs are described as 'third places' that are not always well-integrated with community developments and practices. Framed in a positive way, living labs provide safe spaces for co-experimenting with innovation in the public sector close to a user/stakeholder context, while still removing pressures, risks and ethical concerns of innovation from everyday practices. Finally, there is little emphasis on the evaluation and impact assessment of living lab activities.

	Individual	Group	Collective
Prioritisation	Individual feedback concerning a specific public service in order to set priorities regarding its development, for example, through surveys or social media.	Participating in an idea generation group concerning a specific public service in order to set priorities regarding its development.	Collectively making decisions regarding priorities across services through organised public meetings.
Design	Individually giving input to the design of a specific public service, for example, through individual interviews.	Participating in a group to help co-design a specific public service, for example, a focus group.	Participating in a collective to provide financing for and develop new services of relevance for a community.
Implementation, delivery	Commenting individually on the delivery of a specific public service concerning how it can be	Participating in a group to express opinions and experiences of the workings of a specific	Debating what the resources of people are in a community for maintaining certain

	maintained, for example, through interviews.	public service delivery concerning its maintenance in daily practice.	services.
Testing, assessment	Individually testing a specific public service in regard to its quality, for example, at a testbed facility.	Testing and assessing a specific public service.	Collectively discussing the quality standards that are acceptable across services in a community.

Table 12: Typology 3 – Areas of co-creation processes for future research (adapted from Nabatchi et al. 2017)

The typology presented in Table 12 as typology 3 is adapted from the review of Nabatchi et al. (2017) in the public service co-production literature. Nabatchi et al. (2017) define co-production as "an umbrella concept that captures a wide variety of activities that can occur in any phase of the public service cycle and in which state actors and lay actors work together to produce benefits" (p. 769). In public services, co-production activities provide a wider context for service co-creation and innovation activities including living lab activities. The typology contributes to our review by providing a framework that can help guide and position different forms of living labs arrangements. Moreover, it can help position the different kinds of arrangement to be studied in future research, herein to other researchers on co-creation. The typology reflects some of the approaches provided by or implied in the literature as a whole. However, it also presents a broader explanatory research framework to explain how the public sector can involve citizens in co-creating services, what the barriers are, and what seems to be problematic or absent – for example, in the case of living labs. Future research could take a broader view of co-creation and evaluate the role and contribution of living labs in this.

We expect that the case studies designed for the next reporting period can contribute with knowledge on how living lab activities can be integrated and institutionalised in public service contexts, how the impact of living activities can be conceptualised, and how to understand the contribution of living lab activities for value co-creation at different stages of the innovation process. Hence, based on the typologies and the findings across data sets, we propose to address the following research avenues prospectively:

1. To conduct more living lab studies based on a practice-oriented approach – to ensure that the domain does not get characterised by positive/normative studies not revealing challenges and biases.
2. To better understand the boundaries between living labs and other user-driven innovation initiatives, herein how and with what living labs contribute to public sector innovation.
3. To explore the role of citizens in living lab initiatives and the potential for active citizenship and democratic processes in public sector innovation.
4. To investigate impact and assessment criteria.

4 Conclusions and synthesis

The report has investigated the scientific literature on living/innovation labs as well as national theoretical, empirical and grey literature on living labs as a potential co-creation area of public sector transformation. The main differences regarding the use and understanding of living labs are mainly related to the research streams and the professions concerned with the approach and less related to specific countries. Thus, the focus of the report shifted from a cross-country comparison of living labs towards a more general literature review – mainly encompassing European literature and living lab initiatives. The EU FP7 projects and the establishment of the European Networks of Living Labs (ENoLL) have supported knowledge sharing and collaboration across Europe to a large degree. As a consequence of the strategic focus on living labs in Europe most research literature stems from this continent – both authors and cases studied. Research literature outside Europe is mainly from Australia, Canada, and South Africa.

The research question for the report was the following:

How are living labs currently used and conceptualised in scientific research and practice, and how does this influence opportunities and limitations regarding value creation and the role of citizens in co-innovation?

Based on the literature review and the themes detected in the scientific literature, Figure 2 below is a tentative answer to this question.

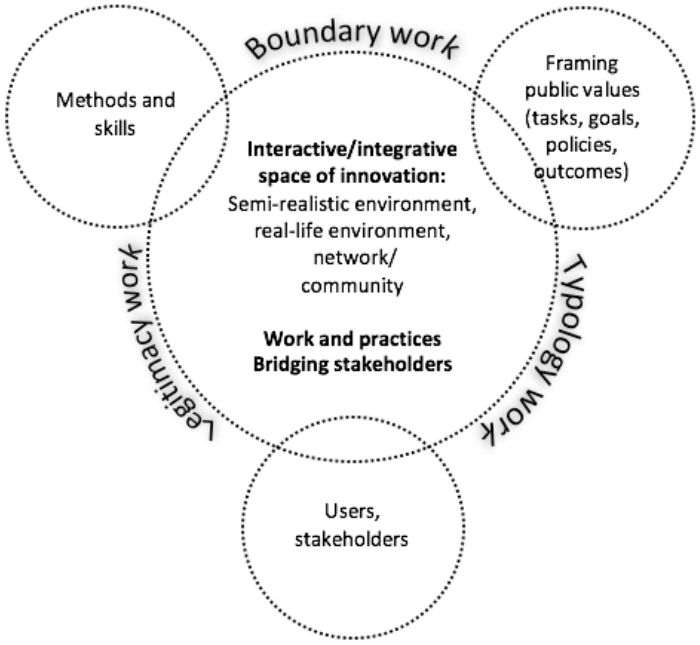

Figure 2: Proposed model for understanding the concept of living lab

Living labs are currently used and conceptualised as various interactive lab-like spaces and processes of co-innovation. They influence opportunities and limitations regarding value creation and the role of

citizens in co-innovation by positioning themselves as possible platforms for integrating methods of innovation, user/stakeholder perspectives and more general values of public services. As such, the literature describes living labs as intermediary practices of innovation and practices of work that bring actors together around an innovation task. At the same time, the literature is concerned with framing the boundaries of living labs to distinguish them from other innovation initiatives, as well as typology work to describe a narrative/history of varied living labs. The literature is also concerned with the legitimacy of living labs in the context of other more mainstream activities in the public sector.

Moreover, the literature review revealed that the literature describes living labs along different dimensions. The context of the living lab is described along a continuum of semi-realistic context, real-life context, and network/community. The task of living labs is described along a continuum of exposing/appropriating innovation in the user context, co-creating with stakeholders, co-researching with stakeholders and democratising innovation.

However, there are several limitations in the literature and open questions with respect to 1) how living lab activities can be integrated into public services; 2) how they can be institutionalised while still evolving dynamically in relation to relevant policy issues; 3) how the contribution of living labs to co-creation and co-innovation can be better conceptualised (including the role of the user-practitioner); and 4) how the impact of living activities can be evaluated. Essentially, the literature does not clarify the boundaries of living labs vis-à-vis other activities very well, the legitimacy of living labs in a public context, the exact role of users in living labs, and how users are integrated with other actors, in what stages of the innovation process, and how the living labs contribute to the creation of public value.

The study illustrates that the citizens are in fact playing a minor role in the co-creation of public services, making this marginal role of citizens a living lab blind spot. Since citizens are mostly framed as users, they are not necessarily part of the decision-making on what public value is and how the delivery of public services should be.

Therefore, we see a need for a refined framework to better understand, explain and evaluate the role of living labs in public service innovation as a tool to sensitise how decisions about public services are made. We consequently propose to develop a typology of living labs to better understand and explain which types of living labs that may be applied in the public sector and for what purposes. This may stimulate more explanatory research about living labs and improve politicians' and public managers' decision-making about living labs as an organisational framework for public decision-making. Hence, we see living lab research in a somewhat broader context of co-production and co-creation that may have a wider interest in the context of public sector services and may enrich the living lab approach. We expect the case studies and the further modelling of living labs (D5.2 and 5.3) to be reported in the next two reporting periods to shed further light on these four issues.

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